

NAPOMENE

Uvod

- 1 Fascinantno istraživanje Harvardovog biologa Majkla Desaja, o gljivicama koje se mogu reprodukovati i klonalno i polno, pokazalo je da se gljivice koje se reprodukuju polno adaptiraju dvaput brže u odnosu na svoje bespolno reprodukovane pandane, što omogućava redukovanje štetnih i širenje korisnih mutacija. Michael J. McDonald, Daniel P. Rice, and Michael M. Desai. “Sex Speeds Adaptation by Altering the Dynamics of Molecular Evolution.” *Nature* 531, no. 7593 (2016): 233–36. Vid: <https://www.nature.com/articles/nature17143>.
- 2 Izvod iz pomenutog svedočenja, održanog 19. juna 2008. Vid. https://fas.org/irp/congress/2008_hr/genetics.pdf.

Prvo poglavlje

U kome Darvin upoznaje Mendela

- 1 Za izuzetan vizuelni prikaz ovoga, vid. Courtney K. Ellison, Triana N. Dalia, Alfredo Vidal Ceballos, Joseph Che-Yen Wang, Nicolas Biais, Yves V. Brun, and Ankur B. Dalia. “Retraction of DNA-Bound Type IV Competence Pili Initiates DNA Uptake during Natural Transformation in *Vibrio Cholerae*.” *Nature Microbiology*, 2018, <https://www.nature.com/articles/s41564-018-0174-y>, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6582970/>.

- 2 Priya Verma, "Reproduction and the Discovery of Sperm," *Elawoman*, pristupljeno 25. juna, 2018; <https://elawomn.quora.com/Reproduction-and-the-Discovery-of-Sperm>.
- 3 F. Gilbert, "Structure of the Gametes," u *Developmental Biology*, 6th edition. (Sunderland, MA: Sinauer Associates, 2000), <https://www.ncbi.nlm.nih.gov/books/NBK10005/>.
- 4 Neki antropolozi dokazuju da su ljudi počeli da domestikuju useve pre oko 23 hiljade godina. Vid. Ainit Snir, Dani Nadel, Iris Groman-Yaroslavski, Yoel Melamed, Marcelo Sternberg, Ofer Bar-Yosef, and Ehud Weiss. "The Origin of Cultivation and Proto-Weeds, Long Before Neolithic Farming," *Plos One* 10, no. 7 (2015), <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0131422>.
- 5 Većina ovih epigenetskih oznaka razvija se od nule u novozačetom organizmu, ali najnovija istraživanja pokazuju da se malom procentu ipak nasleđuju od roditelja datog organizma. Ovo je navelo neke naučnike da počnu da preispituju dosadašnje uverenje kako su teorije Žan-Batista Lamarka bile potpuno pogrešne.
- 6 Za detaljniji istorijat sekvenciranja DNK, vid. James M. Heather and Benjamin Chain, "The Sequence of Sequencers: The History of Sequencing DNA," *Genomics* 107, no. 1 (2016): 1–8, <https://www.sciencedirect.com/science/article/pii/S0888754315300410?via%3Dhub>.
- 7 John J. Kasianowicz and Sergey M. Bezrukov, "On Three Decades of Nanopore Sequencing," *Nature Biotechnology* 34 (2016): 481–482; <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6301005/>.
- 8 "OMIM Entry Statistics," podatak od 24. jula 2018; <http://www.omim.org/statistics/entry>.
- 9 Vid. Jason L. Vassy et al., "The Impact of Whole-Genome Sequencing on the Primary Care and Outcomes of Healthy Adult Patients," *Annals of Internal Medicine* 167, no. 3 (2017): 159, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5856654/>; i P. Natarajan et al., "Aggregate Penetrance of Genomic Variants for Actionable Disorders in European and African Americans,"

- Science Translational Medicine* 8, no. 364 (2016), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5823271/>.
- 10 Rachel D. Melamed et al., "Genetic Similarity between Cancers and Comorbid Mendelian Diseases Identifies Candidate Driver Genes," *Nature Communications*, no. 1 (2015), <https://www.nature.com/articles/ncomms8033>.
- 11 Vid. Lidewij Henneman et al., "Responsible Implementation of Expanded Carrier Screening," *European Journal of Human Genetics* 24, no. 6 (June 2016): e1–e12. Objavljen na internetu 16. marta 2016. <https://www.nature.com/articles/ejhg2015271>; i Nancy C. Rose, "Expanded Carrier Screening: Too Much of a Good Thing?" *Prenatal Diagnosis* 35, no. 10 (2015): 936–37, doi:10.1002/pd.4638.
- 12 Heather Mason Kiefer, "Gallup Brain: The Birth of In Vitro Fertilization," *Gallup News*, August 5, 2003, <http://news.gallup.com/poll/8983/gallup-brain-birth-vitro-fertilization.aspx>.
- 13 Kiefer, "Gallup Brain."
- 14 John M. Haas, "Begotten Not Made: A Catholic View of Reproductive Technology," Konferencija katoličkih biskupa Sjedinjenih Američkih Država, 1998, <http://www.usccb.org/issues-and-action/human-life-and-dignity/reproductive-technology/begotten-not-made-a-catholic-view-of-reproductive-technology.cfm>.
- 15 Jason Pontin, "Science Is Getting Us Closer to the End of Infertility," *Wired*, March 27, 2018, <https://www.wired.com/story/reverse-infertility/>.
- 16 G. Edwards and R. L. Gardner, "Sexing of Live Rabbit Blastocysts," *Nature* 214 (1967): 576–77, <https://www.nature.com/articles/214576a0>.
- 17 Genome Editing and Human Reproduction. Report. July 17, 2018, Nuffield Council on Bioethics. <https://nuffieldbioethics.org/publications/genome-editing-and-human-reproduction>, PDF, str. 10.

- 18 Henry T. Greely, *The End of Sex and the Future of Human Reproduction* (Cambridge: Harvard University Press, 2016): 114, 331.
- 19 Matematika je malo složenija nego što nagoveštava ovaj preliminarni račun, zato što je PGT za određene kategorije genetskih poremećaja precizniji nego za neke druge. Recessivna stanja kod kojih su oba roditelja heterozigotna, na primer, bilo bi statistički lakše identifikovati nego dominantno stanje kod kojeg je jedan roditelj homozigotni nosilac, a drugi nenosilac.
- 20 Petula Dvorak, “Parents Who Refuse to Vaccinate Their Children Are Putting Others at Risk,” *Washington Post*, January 26, 2015, https://www.washingtonpost.com/local/parents-who-refuse-to-vaccinate-their-children-are-putting-others-at-risk/2015/01/26/9c538266-a5aa-11e4-a06b-9df2002b86a0_story.html?utm_term=.3b17e2cf1ccf.
- 21 “Vaccines Do Not Cause Autism,” Centers for Disease Control, od 23. novembra 2015, <https://www.cdc.gov/vaccinesafety/concerns/autism.html>.
- 22 Laura Entis, “Donald Trump Has Long Linked Autism to Vaccines. He Isn’t Stopping Now That He’s President,” *Fortune*, February 16, 2017, <http://fortune.com/2017/02/16/donald-trump-autism-vaccines/>.
- 23 Cary Funk, Brian Kennedy, and Meg Hefferon, “Public Opinion about Childhood Vaccines for Measles, Mumps, and Rubella,” Pew Research Center, February 2, 2017, https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2017/02/PS_2017.02.02_Vaccines_FINAL.pdf.
- 24 Norbert Gleicher and Raoul Orvieto, “Is the Hypothesis of Preimplantation Genetic Screening (PGS) Still Supportable? A Review,” *Journal of Ovarian Research* 10 (2017), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5368937/>. U kritičkom prikazu 455 publikacija na temu genetičkog skrininga, objavljen u martu 2017, tvrdi se da je, prilikom skrininga ljudskih embriona u početnoj fazi na genetske anomalije, stopa lažno pozitivnih rezultata bila veća od pretpostavljene, zato što su obe celije s ovim mutacijama bile neravnomerno raspoređene

- među embrionima i zato što lekari nisu bili u potpunosti svesni sposobnosti embriona da sami isprave problem.
- 25 Julian Quinones and Arijeta Lajka, “What Kind of Society Do You Want to Live In?: Inside the Country Where Down Syndrome Is Disappearing,” *CBS News*, August 15, 2017, <https://www.cbsnews.com/news/down-syndrome-iceland/>.
- 26 Susannah Maxwell, Carol Bower, and Peter O’Leary, “Impact of Prenatal Screening and Diagnostic Testing on Trends in Down Syndrome Births and Terminations in Western Australia 1980 to 2013,” *Prenatal Diagnosis* 35 (2015): 1324–1330; Manya Koetse, “The Last Downer: China and the End of Down Syndrome,” *What’s On Weibo*, May 2, 2016, <https://www.whatsonweibo.com/china-endsyndrome/>; Polina Bachlakova, “Why Are 95% of Danish Women Aborting Babies with Severe Developmental Disabilities?” *VICE News*, April 24, 2015, <https://www.vice.com/da/article/ex9daw/why-are-95-of-danish-women-aborting-babies-with-severedevelopmental-disabilities-020>; Myrthe Jacobs et al., “Pregnancy Outcome Following Prenatal Diagnosis of Chromosomal Anomaly: A Record Linkage Study of 26,261 Pregnancies,” *Plos One* 11 (2016).
- 27 Yuval Levin, “Public Opinion and the Embryo Debates,” *The New Atlantis* 20 (2008): 47–62, <https://www.thenewatlantis.com/publications/public-opinion-and-the-embryo-debates>.
- 28 Jaime L. Natoli et al., “Prenatal Diagnosis of Down Syndrome: A Systematic Review of Termination Rates (1995–2011),” *Prenatal Diagnosis* 32 (2012): 142–153, <http://onlinelibrary.wiley.com/doi/10.1002/pd.2910/abstract;jsessionid=48749E1687B81B0E20AD9593>.
- 29 Henry T. Greely, *The End of Sex and the Future of Human Reproduction* (Cambridge: Harvard University Press, 2016).
- 30 Kees van Gool et al., “Understanding the Costs of Care for Cystic Fibrosis: An Analysis by Age and Health State,” *Value in Health* 16 (2013): 345–355, <https://www.sciencedirect.com/science/article/pii/S1098301512042684>. Studija iz 2010. godine bila je daleko agresivnija u procenama ušteda koje bi donelo sprečavanje pojave cistične fibroze putem PGT procedure.

Tvrdeći kako prosečan dodatni trošak nege osobe sa cističnom fibrozom iznosi 63.127 dolara za prosečan životni vek od trideset sedam godina, autori procenjuju kumulativnu uštedu u periodu od trideset sedam godina na 33,3 milijarde dolara, što je daleko veća cifra od moje. Pored toga, prema tvrdnjama autora, "mogao bi se sprečiti i kumulativni zbir od 618.714 godina patnji pacijenata zbog cistične fibroze, kao i hiljade abortusa". Ove više procene samo dodatno potvrđuju isplativost univerzalnog skrininga embriona. I. Tur-Kaspa et al., "PGT for All Cystic Fibrosis Carrier Couples: Novel Strategy for Preventive Medicine and Cost Analysis." *Reproductive BioMedicine Online* 21, no. 2 (2010): 186–95. [https://www.rbmojournal.com/article/S1472-6483\(10\)00291-9/fulltext](https://www.rbmojournal.com/article/S1472-6483(10)00291-9/fulltext).

- 31 Victoria Divino et al., "The Direct Medical Costs of Huntington's Disease by Stage: A Retrospective Commercial and Medicaid Claims Data Analysis," *Journal of Medical Economics* 16 (2013): 1043–1050,
- 32 David Sable, "Why the Future of Precision Medicine Runs through the IVF Lab." *Forbes*, April 22, 2018. <https://bit.ly/2FF2NaS>.
- 33 "Findings Suggest Increased Number of IVF Cycles Can Be Beneficial," *The JAMA Network*, December 22, 2015, <https://media.jamanetwork.com/news-item/findings-suggest-increased-number-of-ivf-cycles-can-be-beneficial/>.
- 34 Said M. Yildiz and M. Mahmud Khan, "Opportunities for Reproductive Tourism: Cost and Quality Advantages of Turkey in the Provision of In-Vitro Fertilization (IVF) Services," *BMC Health Services Research* 16 (2016): 378, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4982316/>.
- 35 Ido Efrati, "Israel Remains an IVF Paradise as Number of Treatments Rises 11% in 2016," *Haaretz*, May 11, 2017, <https://www.haaretz.com/israel-news/.premium-israel-remains-as-ivf-paradise-as-number-of-treatments-rises-1.5470164>.
- 36 David Sable, "The Seven Trends That Define the Future of IVF," *Forbes*, February 28, 2015, <https://www.forbes.com/sites/davidsable/2015/02/28/the-seven-trends-that-define-the-future-of-ivf/#2ace6bb9494b>.

- 37 Claire Cain Miller, "Freezing Eggs as Part of Employee Benefits: Some Women See Darker Message," *New York Times*, October 14, 2014, <https://www.nytimes.com/2014/10/15/upshot/egg-freezing-as-a-work-benefit-some-women-see-darker-message.html>.
- 38 Charlotte Alter, "Sheryl Sandberg Explains Why Facebook Covers Egg-Freezing," *Time*, April 25, 2015, <http://time.com/3835233/sheryl-sandberg-explains-why-facebook-covers-egg-freezing/>.
- 39 The FertilityIQ Family Builder Workplace Index: 2017–2018, <https://www.fertilityiq.com/topics/fertilityiq-data-and-notes/fertilityiq-best-companies-to-work-for-family-builder-workplace-index-2017-2018>.
- 40 Cenim da je opšte prihvatanje preimplantacionog skrininga embriona rašireno u manjoj meri nego što se predviđalo. Razlog je verovatno to što je procedura još u ranoj fazi razvoja, skupa je, još ima dosta zemalja u kojima nije obuhvaćena zdravstvenim osiguranjem, a i medicinske i društvene norme još evoluiraju. Moguće je da će se PGT u raznim delovima sveta prihvatiti različitom brzinom, ali tvrdim da će to s vremenom ići sve brže, s najvećim porastom te stope u zemljama kao što je Kina.

Drugo poglavlje

Uspon na leštveci složenosti

- 1 Za više o "multiomičkim" biološkim sistemima, vid. Yehudit Hasin, Marcus Seldin, and Aldons Lusism, "Multi-Omics Approaches to Disease." *Genome Biology*, May 5, 2017, od 26. juna 2018, <https://genomebiology.biomedcentral.com/articles/10.1186/s13059-017-1215-1>, i Marc Santolini et al., "A Personalized, Multiomics Approach Identifies Genes Involved in Cardiac Hypertrophy and Heart Failure." *NPJ Systems Biology and Applications* 4, no. 1 (2018), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5825397/>.

-
- 2 Erika Check Hayden, "Human Genome at Ten: Life Is Complicated," *Nature* 464 (2010): 664–667, <https://www.nature.com/news/2010/100331/full/464664a.html>.
- 3 Hayden, "Human Genome at Ten."
- 4 Holley, Peter, "Elon Musk's Nightmarish Warning: AI Could Become 'An Immortal Dictator from Which We Would Never Escape,'" *Washington Post*, April 6, 2018, <https://www.washingtonpost.com/news/innovations/wp/2018/04/06/elon-musks-nightmarish-warning-ai-could-become-an-immortal-dictator-from-which-we-would-never-escape/>.
- 5 "How Much Data Does the World Generate Every Minute?" IFL Science, <http://www.iflscience.com/technology/how-much-data-does-the-world-generate-every-minute/>.
- 6 Deep Genomics, <https://www.deepgenomics.com/>.
- 7 Sara Castellanos, "Quantum Computing May Speed Drug Discovery, Biogen Test Suggests," *Wall Street Journal*, June 13, 2017, <https://blogs.wsj.com/cio/2017/06/13/quantum-computing-may-speed-drug-discovery-biogen-test-suggests/>.
- 8 "The World's Most Valuable Resource Is No Longer Oil, but Data," *The Economist*, May 6, 2017, <https://www.economist.com/news/leaders/21721656-data-economy-demands-new-approach-antitrust-rules-worlds-most-valuable-resource>.
- 9 Stephen Hsu, "Genomic Prediction of Complex Traits", lecture, The Paul G. Allen Frontiers Group, January 19, 2018, <http://infoproc.blogspot.com/2018/01/allen-institute-meeting-on-genetics-of.html>.
- 10 Michael D. Lemonick, "The Iceland Experiment," *Time*, February 12, 2006, <http://content.time.com/time/printout/0,8816,1158968,00.html#>.
- 11 "Harnessing the Power of Genomics through Global Collaborations and Scientific Innovation," AstraZeneca, January 12, 2018, accessed August 5, 2018, <https://www.astrazeneca.com/mediacentre/articles/2017/harnessing-the-power-of-genomics-through-global-collaborations-and-scientificinnovation-12012018.html>.
- 12 "The 1,000 Genomes Project," Genomics England, <https://www.genomicsengland.co.uk/the-100000-genomes-project/>.
- 13 All of Us, National Institutes of Health, <https://allofus.nih.gov/>; Gina Kolata, "The Struggle to Build a Massive 'Biobank' of Patient Data," *New York Times*, March 19, 2018, <https://www.nytimes.com/2018/03/19/health/nih-biobank-genes.html>; Megan Molteni, "The NIH Launches Its Ambitious Million-Person Genetic Survey," *Wired*, May 5, 2018, accessed June 1, 2018, <https://www.wired.com/story/all-of-us-launches/>.
- 14 Od 2018. godine sekvencirano je oko 600 hiljada veterana. "Million Veteran Program (MVP)," Office of Research and Development, U.S. Department of Veterans Affairs, <https://www.research.va.gov/mvp/>.
- 15 LunaDNA, pristupljeno 17. juna 2018, <https://www.lunadna.com/>. Nebjula dženomiks (Nebula Genomics) takođe koristi blokčejn tehnologiju da klijentima pomogne da razumeju kako se koriste njihove genetske informacije, kao i koristi od komercijalnih aktivnosti koje okružuju te informacije.. "Nebula Genomics," pristupljeno 27. avgusta 2018, <https://www.nebulagenomics.io/>.
- 16 Započet 2005, Projekat ličnog genoma je međunarodna koalicija genomske projekata koja koristi open-source, dobrovoljnu strategiju da objedini ogromne fondove genetskih informacija uskladene s medicinskim i ličnim podacima. Prema navodima Madlen Prajs Bol, suosnivačice Projekta otvorenih ljudi (Open Humans Project), koja rukovodi Projektom ličnog genoma, od marta 2018, partneri u Sjedinjenim Državama, Kanadi, Ujedinjenom Kraljevstvu, Austriji i Kini sakupili su ukupno svega 522 genoma.
- 17 David Cyranoski, "China's Bid to Be a DNA Superpower," *Nature* 534 (2016): 462–463, <http://www.nature.com/news/china-s-bid-to-be-a-dna-superpower-1.20121>.
- 18 Da navedem samo jedan primer, kineska provincija Čangsu udružila se s Nacionalnom komisijom za zdravlje i planiranje porodice u projektu sekvenciranja gena milion ispitanika i stvaranja najvećeg centra za sekvenciranje gena milion ispitanika i „big data“ analitiku

- u Aziji. Kineske kompanije BGI Šendžen (BGI Shenzhen) i VuSi nekstKOD, ogranačkih islandskog deKOD-a, takođe grade ogromne genomičke baze podataka. Vid. Dou Shicong, "Jiangsu Government Unveils Plans to Sequence Genes of 1 Million Subjects," *Yicai Global*, October 30, 2017, <https://www.yicai-global.com/news/jiangsu-governmentunveils-plans-sequence-genes-1-million-subjects>; "Jiangsu Officially Launches Million Population Genome Sequencing Project," *China News*, October 29, 2017, <http://www.chinanews.com/gn/2017/10-29/8362987.shtml>; Preetika Rana, "Made-to-Order Medicine: China, U.S. Race to Decode Your Genes," *Wall Street Journal*, September 20, 2017, <https://www.wsj.com/articles/china-rushes-to-superpass-u-s-in-decoding-citizens-genes-1505899806>; David Cyranoski, "China Embraces Precision Medicine on a Massive Scale," *Nature News*, January 6, 2016, <https://www.nature.com/news/china-embraces-precision-medicine-on-a-massive-scale-1.19108>.
- 19 Bertil Schmidt and Andreas Hildebrandt, "Next-Generation Sequencing: Big Data Meets High Performance Computing," *Drug Discovery Today* 22 (2017): 712–717, <https://www.ncbi.nlm.nih.gov/pubmed/28163155>.
- 20 Valeria D'Argenio, "The High-Throughput Analyses Era: Are We Ready for the Data Struggle?" *High-Throughput* 7 (2018): 8; <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5876534/>.
- 21 "White House Precision Medicine Initiative," National Archives and Records Administration, <https://obamawhitehouse.archives.gov/node/333101>. Ova inicijativa je kasnije prerasla u inicijative nazvane "Cancer Moonshot and All of Us". William Lane i kolege objavili su 2018. važnu studiju koja pokazuje kako se sekvenciranjem kompletног genoma tip krvи za transfuziju može odrediti daleko preciznije nego tradicionalnom metodom i tako potencijalno spasti mnogo života. Robert Flower, Eileen Roulis, and Catherine Hyland, "Whole-Genome Sequencing Algorithm for Blood-Group Typing," *The Lancet Haematology* 5, no. 6 (2018): doi:10.1016/s2352-3026(18)30064-4.

- 22 Ellie Kincaid, "Geisinger Says DNA Sequencing as Preventative Care Is Ready for the Clinic," *Forbes*, May 9, 2018, pristupljeno 12. maja 2018, <https://www.forbes.com/sites/elliekincaid/2018/05/07/geisinger-says-dna-sequencing-as-preventative-care-is-ready-for-the-clinic/#60fc3ba34d63>.
- 23 Robert Green et al., "Whole-Genome Sequencing in Primary Care," *Annals of Internal Medicine* 167, no. 3 (2017): <https://annals.org/aim/fullarticle/2633850/whole-genome-sequencing-primary-care>.
- 24 Amit V. Khera et al., "Genome-Wide Polygenic Scores for Common Diseases Identify Individuals with Risk Equivalent to Monogenic Mutations," *Nature Genetics* 50 (August 13, 2018): <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6128408/>.
- 25 "About Genomic Prediction," Genomic Prediction, accessed August 5, 2018, <https://genomicprediction.com/about/>.

Treće poglavlje

Dekodiranje identiteta

- 1 Bouchard et al., "Sources of Human Psychological Differences: The Minnesota Study of Twins Reared Apart," *Science* 250 (1990): 223–228, <https://www.ncbi.nlm.nih.gov/pubmed/2218526>.
- 2 Bouchard et al., "Sources of Human Psychological Differences."
- 3 J. Polderman et al., "Meta-Analysis of the Heritability of Human Traits Based on Fifty Years of Twin Studies," *Nature Genetics* 47 (2015): 702–709, <https://www.ncbi.nlm.nih.gov/pubmed/25985137>.
- 4 Daniel Schwerkendiek, "Determinants of Well-Being in North Korea: Evidence from the Post-Famine Period," *Economics & Human Biology* 6 (2008): 446–454. Neuhranjenost majke za vreme trudnoće može kod novorođenčeta dovesti do ometene kognitivne funkcije, nižeg rasta, imunodeficijencije, kraćeg

- životnog veka i mnogih drugih problema. Caroline H. D. Fall, "Fetal Malnutrition and Long-Term Outcomes," in *Maternal and Child Nutrition: The First 1,000 Days*, 74th Nestlé Nutrition Institute Workshop Series (2013): 11–25, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5081104/>.
- 5 Chao-Qiang Lai, "How Much of Human Height Is Genetic and How Much Is Due to Nutrition?" *Scientific American*, December 11, 2006, [https://www.scientificamerican.com/article/how-much-ofhuman-height/](https://www.scientificamerican.com/article/how-much-of-human-height/).
 - 6 Louis Lello et al., "Accurate Genomic Prediction of Human Height," *BioRxiv* (2017), <https://www.biorxiv.org/content/early/2017/10/07/190124>.
 - 7 Lello et al.; Stephen Hsu, "Genomic Prediction of Complex Traits," lecture, The Paul G. Allen Frontiers Group, January 19, 2018, <http://infoproc.blogspot.com/2018/01/allen-institute-meeting-on-genetics-of.html>.
 - 8 Ian J. Deary, "Intelligence," *Current Biology* 23 (2013): R673–R676, [http://www.cell.com/currentbiology/fulltext/S0960-9822\(13\)00844-0](http://www.cell.com/currentbiology/fulltext/S0960-9822(13)00844-0); Yan Zhang et al., "Estimation of Complex Effect-Size Distributions Using Summary-Level Statistics from Genome-wide Association Studies across 32 Complex Traits and Implications for the Future," *BioRxiv* (2017), <https://www.biorxiv.org/content/biorxiv/early/2017/08/11/175406.full.pdf>; Stephen Hsu, "Genomic Prediction of Complex Traits."
 - 9 Yan Zhang et al., "Estimation of Complex Effect-Size Distribution."
 - 10 Deary, "Intelligence."
 - 11 Charles Spearman, "'General Intelligence,' Objectively Determined and Measured," *American Journal of Psychology* 15, no. 2 (1904): 201–93, https://www.jstor.org/stable/1412107?seq=1#metadata_info_tab_contents.
 - 12 Brian Resnick, "IQ, Explained in 9 Charts," Vox, October 10, 2017, <https://www.vox.com/2016/5/24/11723182/iq-test-intelligence>. Robert Plomin and Sophie Von Stumm, "The New Genetics of Intelligence," *Nature Reviews Genetics* 19, no. 3

- (2018): 148–59, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5985927/>.
- 13 Patrick F. McKay et al., "The Effects of Demographic Variables and Stereotype Threat on Black/White Differences in Cognitive Ability Test Performance," *Journal of Business and Psychology* 18 (2003): 1–14, <https://link.springer.com/article/10.1023/A:1025062703113>. Vid. i Daphne Martschenko, "The IQ Test Wars: Why Screening for Intelligence Is Still So Controversial," *The Conversation*, October 10, 2017, accessed June 26, 2018, <https://theconversation.com/the-iq-test-wars-why-screening-forintelligence-is-still-so-controversial-81428>.
 - 14 Richard J. Herrnstein and Charles A. Murray, *The Bell Curve: Intelligence and Class Structure in American Life* (New York: Free Press, 1997). Ova knjiga je prvi put objavljena 1994. godine.
 - 15 Bob Herbert, "In America; Throwing a Curve," *New York Times*, October 26, 1994, accessed June 26, 2018. <https://www.nytimes.com/1994/10/26/opinion/in-america-throwing-a-curve.html>.
 - 16 Stephen Jay Gould, "Curveball," *New Yorker*, November 28, 1994, <http://www.dartmouth.edu/~chance/course/topics/curveball.html>. Za promišljenu, snažnu kritiku Zvonolike krivulje vid. i *The Gene: An Intimate History* (London: Vintage, 2017). (Srpski prevod: Sidarta Mukardžić, *Gen: Intimna istorija* (Laguna, Beograd, 2018)).
 - 17 Za komplilaciju nekih od ovih kritika vid. Steve Fraser, *The Bell Curve Wars: Race, Intelligence, and the Future of America* (New York: BasicBooks, 1998). Vid. i Eric Siegel, "The Real Problem with Charles Murray and 'The Bell Curve,'" *Scientific American* Blog Network, April 12, 2017, accessed June 17, 2018. <https://blogs.scientificamerican.com/voices/the-real-problem-with-charles-murray-and-the-bell-curve/>.
 - 18 Ponovo objavljeno u Linda S. Gottfredson, "Mainstream Science on Intelligence: An Editorial with 52 Signatories, History, and Bibliography," *Intelligence* 24, no. 1 (1997): 13–23, doi:10.1016/s0160-2896(97)90011-8. Američko udruženje psihologa (American Psychological Association) formiralo je i specijalnu

- operativnu grupu sa zadatkom da proceni nalaze knjige, koje je došlo do sličnih rezultata.
- 19 Bouchard et al., "Sources of Human Psychological Differences."
 - 20 Plomin and I. J. Deary, "Genetics and Intelligence Differences: Five Special Findings," *Molecular Psychiatry* 20 (2014): 98–108, <https://www.nature.com/articles/mp2014105.pdf>.
 - 21 Thomas J. Bouchard, "The Wilson Effect: The Increase in Heritability of IQ with Age," *Twin Research and Human Genetics* 16, no. 5 (2013): 923–30, https://www.researchgate.net/publication/255692897_The_Wilson_Effect_The_Increase_in_Heritability_of_IQ_With_Age. Pošto je IQ relativan pojam, genetika bi morala da bude važniji faktor IQ-a dok starimo, u odnosu na starenje drugih ljudi. Druga studija nagoveštava je osamdeset procenata IQ-a heritabilno. Valerie S. Knopik et al., *Behavioral Genetics*, 7th ed. (Worth Publishers, 2016); Susan Bouregy, Elena L. Grigorenko, and Stephen R. Latham, *Genetics, Ethics and Education* (Cambridge: Cambridge University Press, 2017).
 - 22 Eric Turkheimer et al., "Socioeconomic Status Modifies Heritability of IQ in Young Children," *Psychological Science* 14 (2003): 623–628. https://www.researchgate.net/publication/8997472_Socioeconomic_Status_Modifies_Heritability_of_IQ_in_Young_Children.
 - 23 Mutacije i varijante su u suštini jedno te isto, ali mutacijama smo skloni da ih nazivamo kad su povezane s bolestima i generalno ređe, dok one uobičajenije, koje utiču na karakteristike nepovezane s bolestima nazivamo varijantama. Neki istraživači su stoga odnedavno počeli da upotrebljavaju izraz patogene varijante umesto mutacije. No budući da granica između poremećaja i karakteristike često nije baš najjasnije definisana, ovi pojmovi su umnogome izmenjivi.
 - 24 D. Hill et al., "A Combined Analysis of Genetically Correlated Traits Identifies 187 Loci and a Role for Neurogenesis and Myelination in Intelligence," *Molecular Psychiatry* (2018): doi:10.1038/s41380-017-0001-5, <https://www.nature.com/articles/s41380-017-0001-5>; D. Zabaneh et al., "A Genome-Wide

- Association Study for Extremely High Intelligence," *Molecular Psychiatry* 23 (July 4, 2017): 1226–1232, <https://www.nature.com/articles/mp2017121>; Gail Davies et al., "Ninety-Nine Independent Genetic Loci Influencing General Cognitive Function Include Genes Associated with Brain Health and Structure," *BioRxiv* (2017), <https://www.biorxiv.org/content/biorxiv/early/2017/08/18/176511.full.pdf>; Robert Plomin and Sophie von Stumm, "The New Genetics of Intelligence," *Nature Reviews Genetics* 19 (January 8, 2018): 148–159, doi:10.1038/nrg.2017.104, <https://www.nature.com/articles/nrg.2017.104>. The number will likely exceed two hundred by the time this book is published.
- 25 Suzanne Sniekers et al., "Genome-Wide Association Meta-analysis of 78,308 Individuals Identifies New Loci and Genes Influencing Human Intelligence," *Nature Genetics* 49 (2017): 1107–1112. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5665562/>.
 - 26 Istraživači se već kreću od uzlaznog modela izvođenja zaključaka o opštoj inteligenciji – identifikovanja monogenskih mutacija – u pravcu više silaznog pristupa, zasnovanog na "big data" analitici obrazu identifikovanih u svim ovim mutacijama. Vid. Plomin and Stumm, "The New Genetics of Intelligence."
 - 27 Yan Zhang et al., "Estimation of Complex Effect-Size Distributions Using Summary-Level Statistics from Genome-wide Association Studies across 32 Complex Traits and Implications for the Future," *BioRxiv* (2017), <https://www.biorxiv.org/content/biorxiv/early/2017/08/11/175406.full.pdf>; Stephen Hsu, "Genomic Prediction of Complex Traits," lecture, The Paul G. Allen Frontiers Group, January 19, 2018, <http://infoproc.blogspot.com/2018/01/allen-institute-meeting-on-genetics-of.html>; "Heritability," SNPedia, last modified March 13, 2018, <https://www.snpedia.com/index.php/Heritability>. Na preliminarnom spisku bolesti i stanja ljudskog organizma za koje se procenjuje da su pedeset odsto ili više genetske prirode (SNPedia.com, slobodna internetska baza podataka koja objedinjava naučna istraživanja iz celog sveta) nalaze se: aneurizma trbušne aorte, akne, degeneracija makule, alkoholizam,

Alchajmerova bolest, androgena alopecija, anoreksija, hiperaktivni poremećaj nedostatka pažnje, slabost brade (alopecia barbae), bipolarni poremećaj, mineralna gustina kostiju, celijakija, hronična opstruktivna bolest pluća, Kronova bolest, Dipitrenova kontraktura, ekcem, epilepsija, boja očiju, broj pega, Grevs-Bazdovljeva bolest, boja kose, kovrdžavost kose, visina, kamenac u bubregu, lupus, menarha, spojene obrve, sindrom policističnih jajnika, psorijaza, reumatoidni artritis, šizofrenija, seksualna orijentacija, mucanje, karcinom štitaste žlezde, Turetov sindrom, dijabetes tip 1 i proširene vene. Konačni spisak obuhvataće desetine hiljada bolesti i karakteristika.

- 28 Bouchard et al., “Sources of Human Psychological Differences.”
- 29 Min-Tzu Lo et al., “Genome-Wide Analyses for Personality Traits Identify Six Genomic Loci and Show Correlations with Psychiatric Disorders,” *Nature Genetics* 49 (2017): 152–156, <https://www.nature.com/articles/ng.3736>.

Četvrto poglavje

Kraj seksa

- 1 “Masturbatorium,” Wiktionary, <https://en.wiktionary.org/wiki/masturbatorium>.
- 2 “Odontophilia,” Urban Dictionary, <https://www.urbandictionary.com/define.php?term=Odontophilia>. Vid. i: Odontofilija (gr. odus – zub + filia – ljubav): 1. seksualno uzbuđenje izazvano nečijim zadahom iz usta; 2. fetiš zuba, <http://www.geocities.ws/cssbeograd/recmik.htm>.
- 3 Među industrijalizovanim zemljama, Japan je na prvom mestu po procentu novorođenčadi začetih veštačkom oplođnjom, ali i na poslednjem mestu po stopi uspešnosti procedure. Razlog za to je što su žene koje se podvrgavaju veštačkoj oplođnji starije od svojih pandana u ostalim zemljama, kao i to što su standardi za ovu proceduru u Japanu nedosledni. Vid. “A Corked Tube: No Country Resorts to IVF More

Than Japan—or Has Less Success,” *The Economist*, May 26, 2018, <https://www.economist.com/asia/2018/05/26/no-country-resorts-to-ivf-more-than-japan-or-has-less-success>.

- 4 Gary J. Gates, “In U.S., More Adults Identifying as LGBT,” Gallup, January 11, 2017, <http://news.gallup.com/poll/201731/lgbt-identification-rises.aspx>. Metode utvrđivanja tačne veličine američke i svetske LGBTQIAP (lezbiske, gej, biseksualne, transrodne, kvir, interseksualne, asekualne i panseksualne) populacije su inherentno nesavršene i ne uzimaju u obzir fluidnost rodne i seksualne orientacije, pogotovo među mlađim generacijama. Vid. Katy Steinmetz, “Inside the Efforts to Finally Identify the Size of the Nation’s LGBT Population,” *Time*, May 18, 2016, <http://time.com/lgbt-stats/>.
- 5 Elizabeth Cohen, “Researchers Isolate Human Stem Cells in the Lab,” CNN Interactive, November 5, 1998, <http://www.cnn.com/HEALTH/9811/05/stem.cell.discovery/>.
- 6 Jessica Reaves, “The Great Debate over Stem Cell Research,” *Time*, July 11, 2001, <http://content.time.com/time/nation/article/0,8599,167245,00.html>.
- 7 Hayashi, “Offspring from Oocytes Derived from In Vitro Primordial Germ Cell-Like Cells in Mice,” *Science* 16 (2012): 971–975, <https://www.ncbi.nlm.nih.gov/pubmed/23042295>. Zanimljivo je da se Hajaši nalazi na čelu tima koji pokušava da upotrebi tehnologiju indukovanih matičnih ćelija ne bi li se ugroženi beli nosorog spasao od izumiranja.
- 8 David Cyranoski, “Rudimentary Egg and Sperm Cells Made from Stem Cells,” *Nature*, December 24, 2014, <https://www.nature.com/news/rudimentary-egg-and-sperm-cells-made-from-stem-cells-1.16636>.
- 9 Naoko Irie, Shinseog Kim, and M. Azim Surani, “Human Germline Development from Pluripotent Stem Cells In Vitro,” *Journal of Mammalian Ova Research* 33 (2016): 79–87; Naoko Irie and M. Azim Surani, “Efficient induction and Isolation of Human Primordial Germ Cell-like Cells from Competent Human Pluripotent Stem Cells” in *Germline Stem Cells*, ed. Steven X. Hou and Shree Ram Singh, in *Methods in Molecular*

- Biology 1463 (2016): 217–226. Ovde je potreban veliki oprez. Jedan od četiri Jamanakina “master gena” – myc – spada u nاجresivnije katalizatore kancera.
- 10 CIA World Factbook, Central Intelligence Agency, accessed May 21, 2018. <https://www.cia.gov/library/publications/the-world-factbook/fields/2256.html>.
 - 11 Carl Shulman and Nick Bostrom, “Embryo Selection for Cognitive Enhancement: Curiosity or Game-Changer?” Global Policy 5 (2014): 85–92, <https://nickbostrom.com/papers/embryo.pdf>.
 - 12 Stephen Hsu, “Super-Intelligent Humans Are Coming,” Nautilus, October 16, 2014, http://nautil.us/issue/18/genius/super_intelligent-humans-are-coming.

Peto poglavlje

Božanske varnice i vilinska prašina

- 1 “Method of the Year 2011,” Nature Methods 9 (2012): 1, <https://www.nature.com/articles/nmeth.1852>.
- 2 Eric S. Lander, “The Heroes of CRISPR,” Cell 164 (2016): 18–28, [https://www.cell.com/cell/pdf/S0092-8674\(15\)01705-5.pdf](https://www.cell.com/cell/pdf/S0092-8674(15)01705-5.pdf).
- 3 Vid. “CRISPR Off-Targets: A Reassessment,” Nature News, March 30, 2018, accessed May 8, 2018, <https://www.nature.com/articles/nmeth.4664>.
- 4 “SHERLOCK, DETECTR, CAMERA: Three New CRISPR Technologies,” AACC, accessed May 8, 2018, <https://www.aacc.org/publications/cln/cln-stat/2018/march/15/sherlock-detectr-camera-threene-new-crispr-technologies>.
- 5 Pratiksha I. Thakore et al., “Editing the Epigenome: Technologies for Programmable Transcription and Epigenetic Modulation,” Nature Methods 13 (2016): 127–137, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4922638/>.

- 6 David Cano-Rodriguez and Marianne G. Rots, “Epigenetic Editing: On the Verge of Reprogramming Gene Expression at Will,” Current Genetic Medicine Reports 4 (2016): 170–179, <https://link.springer.com/article/10.1007/s40142-016-0104-3>; Heidi Ledford, “CRISPR: Gene Editing Is Just the Beginning,” Nature 531 (2016): 156–159, <https://www.nature.com/news/crispr-geneediting-is-just-the-beginning-1.19510>.
- 7 Emily Waltz, “Gene-Edited CRISPR Mushroom Escapes U.S. Regulation,” Nature 532 (2016): 293, <https://www.nature.com/news/gene-edited-crispr-mushroom-escapes-us-regulation-1.19754>.
- 8 Budući da ni „arktička jabuka“ ni pečurke koje ne oksidišu ne sadrže u sebi nikakvu stranu DNK, one tehnički nisu genetski modifikovane (GMO) u tradicionalnom smislu reči. Dvadeset osmog marta 2018. godine, američki sekretar za poljoprivredu Soni Perdu objavio je da njegovo ministarstvo neće tretirati genski editovane biljke u koje nije unesena strana DNK kao GMO. Ovo je izazvalo uznemirenost među mnogim protivnicima genetskog modifikovanja, zabrinutim zbog bilo kakvih genetskih izmena namirnica. U novembru 2018, koalicija trinaest zemalja, među kojima su SAD, Kanada i Brazil, objavila je na skupu Svetske trgovinske organizacije u Ženevi da će podržati mere koje omogućavaju editovanje genoma u poljoprivredi. Amy Maxmen, “Genetically Modified Apple Reaches U.S. Stores, but Will Consumers Bite?” Nature 551, <https://www.nature.com/news/genetically-modified-apple-reaches-us-stores-but-will-consumers-bite-1.22969>. Vid. i <https://quantumjk.blogspot.com/2017/11/kanadske-gmo-arkticke-jabuke.html>.
- 9 Vitamin A je genetičkim inženjeringom unesen u kukuruz, tapioku i jam; pasulj i proso obogaćeni su gvožđem, a pirinac i pšenica cinkom. Vid. Heather Ohly and Nicola Lowe, “Scientists Are Breeding Super-Nutritious Crops to Help Solve Global Hunger,” The Conversation, June 1, 2018, accessed June 3, 2018, <https://theconversation.com/scientists-are-breeding-super-nutritious-crops-to-help-solve-global-hunger-89815>.

- 10 Bill Gates, "Gene Editing for Good," *Foreign Affairs* (May/June 2018), accessed May 3, 2018, <https://www.foreignaffairs.com/articles/2018-04-10/gene-editing-good>. Takođe vid. <https://www.dw.com/sr/svi-protiv-genetskog-inženjeringa/a-19567521>.
- 11 Tom Whipple, "Bill Gates Pumps Millions into Quest for a Supercow," *The Times*, January 26, 2018, <https://www.thetimes.co.uk/article/bill-gates-pumps-millions-into-quest-for-a-supercow-7swc6dntw>.
- 12 Sara Reardon, "Welcome to the CRISPR Zoo," *Nature* 531 (2016): 160–163, <https://www.nature.com/news/welcome-to-the-crispr-zoo-1.19537>. BGI Šendžen je 2017. godine objavio da napušta program mikrosvinja, po svoj prilici zato što je prašina koju su mediji dizali u vezi s tim odvlačila pažnju od inicijalne ponude BGI grupe (prvog pojavljivanja deonica te kompanije na berzi).
- 13 Za zabavan opis ovog procesa vid. Ben Mezrich, *Woolly: The True Story of the Quest to Revive One of History's Most Iconic Extinct Creatures* (New York: Simon & Schuster, 2018); takođe vid. George Church and Ed Regis, *Regenesis* (New York: Basic Books, 2014): 10–11.
- 14 Barbara Sibbald, "Death But One Unintended Consequence of Gene-Therapy Trial," *Canadian Medical Association Journal* 164 (2001): 1612, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC81135/>; Osagie K. Obasogie, "Ten Years Later: Jesse Gelsinger's Death and Human Subjects Protection," *The Hastings Center*, October 22, 2009, <https://www.thehastingscenter.org/ten-years-later-jesse-gelsingers-death-and-human-subjectsprotection/>.
- 15 Roland W. Herzog, Ou Cao, and Arun Srivastava, "Two Decades of Clinical Gene Therapy—Success Is Finally Mounting," *Discovery Medicine* 9 (2010): 105–11, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3586794/>.
- 16 Ibid.
- 17 Calvin J. Stephens et al., "Targeted In Vivo Knock-in of Human Alpha-1-antitrypsin CDNA Using Adenoviral Delivery of

- CRISPR/Cas9," *Gene Therapy* 25, no. 2 (2018): 139–56. doi:10.1038/s41434-018-0003-1.
- 18 Francis S. Collins and Scott Gottlieb, "The Next Phase of Human Gene-Therapy Oversight," *New England Journal of Medicine* (August 15, 2018): doi:10.1056/nejmp1810628.
- 19 H-Y Xue et al., "In Vivo Gene Therapy Potentials of CRISPR-Cas9," *Gene Therapy* 23 (2016): 557–559, <https://www.nature.com/articles/gt201625>.
- 20 Lukas Villiger et al., "Treatment of a Metabolic Liver Disease by in Vivo Genome Base Editing in Adult Mice," *Nature Medicine* 24, no. 10 (October 2018): 1519–525, doi:10.1038/s41591-018-0209-1.
- 21 Collins and Gottlieb, "The Next Phase of Human Gene-Therapy Oversight."
- 22 Megan Molteni, "Biology Will Be the Next Great Computing Platform," *Wired*, May 3, 2018, accessed May 4, 2018, <https://www.wired.com/story/biology-will-be-the-next-great-computing-platform/>.
- 23 Gerald Schwank et al., "Functional Repair of CFTR by CRISPR/Cas9 in Intestinal Stem Cell Organoids of Cystic Fibrosis Patients," *Cell Stem Cell* 13 (2013): 653–658, [http://www.cell.com/cellstem-cell/fulltext/S1934-5909\(13\)00493-1](http://www.cell.com/cellstem-cell/fulltext/S1934-5909(13)00493-1).
- 24 Hao Yin et al., "Genome Editing with Cas9 in Adult Mice Corrects a Disease Mutation and Phenotype," *Nature Biotechnology* 32 (2014): doi:10.1038/nbt.2884; Yanjiao Shao et al., "Cas9-Nickase-Mediated Genome Editing Corrects Hereditary Tyrosinemia in Rats," *Journal of Biological Chemistry* 293, no. 18 (2018): 6883–892. doi:10.1074/jbc.ra117.000347.
- 25 Puping Liang et al., "CRISPR/Cas9-Mediated Gene Editing in Human Tripromuclear Zygotes," *Protein & Cell* 6 (2015): 363–372, <http://www.ncbi.nlm.nih.gov/pubmed/25894090>.
- 26 Rafal Kaminski, "Elimination of HIV-1 Genomes from Human T-lymphoid Cells by CRISPR/Cas9 Gene Editing," *Scientific Reports* 6 (2016), <https://www.nature.com/articles/srep22555>.

- 27 Hong Ma, "Correction of a Pathogenic Gene Mutation in Human Embryos," *Nature* 548 (2017): 413–419, <https://www.nature.com/articles/nature23305>.
- 28 Chengzu Long et al., "Correction of Diverse Muscular Dystrophy Mutations in Human Engineered Heart Muscle by Single-Site Genome Editing," *Science Advances* 4 (2018), <http://advances.sciencemag.org/content/4/1/eaap9004>.
- 29 Alice Park, "Food and Drug Administration Approves a New Way to Use Gene Therapy," *Time*, December 20, 2017, accessed June 17, 2018. <http://time.com/5073751/gene-therapy-visualimpairment/>.
- 30 Serena H. Chen et al., "A Limited Survey-Based Uncontrolled Follow-Up Study of Children Born after Ooplasmic Transplantation in a Single Centre." *Reproductive BioMedicine Online* 33, no. 6 (2016): 737–44, [https://www.rbmojournal.com/article/S1472-6483\(16\)30556-9/fulltext](https://www.rbmojournal.com/article/S1472-6483(16)30556-9/fulltext).
- 31 Rosa J. Castro, "Mitochondrial Replacement Therapy: The UK and U.S. Regulatory Landscapes," *Journal of Law and the Biosciences* 3 (2016): 726–35, <https://academic.oup.com/jlb/article/3/3/726/2566730>.
- 32 Ian Sample, "UK Doctors Select First Women to Have 'Three-Person Babies,'" *The Guardian*, February 1, 2018, <https://www.theguardian.com/science/2018/feb/01/permission-given-to-createbritains-first-three-person-babies>. Prva od ovih beba rođena je u aprilu 2019. https://www.bionews.org.uk/page_142476. Singapur takođe razmatra mogućnost odobravanja kliničkih ispitivanja mitohondrijskog transfera.
- 33 Darwin Life, <https://www.darwinlife.com/>. U avgustu 2017, međutim, Džang je od FDA dobio dopis u kom ga, u vezi s njegovom javnom ponudom insertovanja DNK starijih žena u donorske jajne ćelije mlađih žena, obaveštavaju da se ta procedura "ne može legalno obavljati u SAD. Isto tako, nije dozvoljen izvoz". Vid. Ariana Eunjung Cha, "This Fertility Doctor Is Pushing the Boundaries of Human Reproduction, with Little Regulation." *Washington Post*, May 14, 2018, accessed June 1, 2018, https://www.washingtonpost.com/national/health-science/this-fertility-doctor-is-pushing-theboundaries-of-human-reproduction-with-little-regulation/2018/05/11/ea9105dc-1831-11e8-8b08-027a6ccb38eb_story.html?utm_term=.220a3ce466e2.

- 34 Rob Stein, "Clinic Claims Success in Making Babies With 3 Parents' DNA." *NPR*, June 06, 2018, accessed June 7, 2018, <https://www.npr.org/sections/health-shots/2018/06/06/615909572/inside-theukrainian-clinic-making-3-parent-babies-for-women-who-are-infertile>.
- 35 C. Salleveld et al., "Preimplantation Genetic Diagnosis for Single Gene Disorders," *Journal of Medical Genetics* 50 (2013): 125–132, <http://jmg.bmjjournals.com/content/50/2/125.long>.
- 36 Shoukhrat Mitalipov et al., "Limitations of Preimplantation Genetic Diagnosis for Mitochondrial DNA Diseases," *Cell Reports* 7, no. 4 (2014): 935–37, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4349563/>.
- 37 "Mitochondrial Replacement Therapy," United Mitochondrial Disease Foundation, <https://www.umdf.org/mitochondrial-replacement-therapy/>.
- 38 Rachel Kahn Best, "Disease Politics and Medical Research Funding," *American Sociological Review* 77 (2012): 780–803, <http://journals.sagepub.com/doi/10.1177/0003122412458509>; Sara Reardon, "Lobbying Sways NIH Grants." *Nature* 515 (November 2014): 19.
- 39 David Cyranoski and Sara Reardon, "Chinese Scientists Genetically Modify Human Embryos," *Nature*, April 22, 2015, <https://www.nature.com/news/chinese-scientists-genetically-modify-humanembryos-1.17378>.
- 40 Ewen Callaway, "Second Chinese Team Reports Gene Editing in Human Embryos," *Nature*, April 8, 2016, <https://www.nature.com/news/second-chinese-team-reports-gene-editing-in-human-embryos-1.19718#/b2>.
- 41 Hong Ma et al., "Correction of a Pathogenic Gene Mutation in Human Embryos," *Nature* 548 (2017): 413–419, <https://www.nature.com/articles/nature23305>.

- 42 Pam Belluck, "In Breakthrough, Scientists Edit a Dangerous Mutation from Genes in Human Embryos," *New York Times*, August 2, 2017, <https://www.nytimes.com/2017/08/02/science/geneediting-human-embryos.html>.

Šesto poglavlje

Ponovna izgradnja živog sveta

- 1 Flannick et al., "Loss-of-Function Mutations in SLC30A8 Protect against Type 2 Diabetes," *Nature Genetics* 46 (2014): 357–363, <https://www.ncbi.nlm.nih.gov/pubmed/24584071>.
- 2 Rong Liu et al., "Homozygous Defect in HIV-1 Coreceptor Accounts for Resistance of Some Multiply-Exposed Individuals to HIV-1 Infection," *Cell* 86 (1996): 367–377, [http://www.cell.com/abstract/S0092-8674\(00\)80110-5](http://www.cell.com/abstract/S0092-8674(00)80110-5).
- 3 Christopher P. Cannon et al., "Ezetimibe Added to Statin Therapy after Acute Coronary Syndromes," *New England Journal of Medicine* 372 (2015): 2387–2397, <http://www.nejm.org/doi/full/10.1056/NEJMoa1410489>.
- 4 Yanfang Fu et al., "High-Frequency Off-Target Mutagenesis Induced by CRISPR-Cas Nucleases in Human Cells," *Nature Biotechnology* 31 (2013): 822–826, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3773023/>.
- 5 David Cyranoski and Sara Reardon, "Chinese Scientists Genetically Modify Human Embryos," *Nature*, April 22, 2015, <https://www.nature.com/news/chinese-scientists-genetically-modify-human-embryos-1.17378>.
- 6 Emma Haapaniemi et al., "CRISPR-Cas9 Genome Editing Induces a P53-mediated DNA Damage Response," *Nature Medicine*, 2018, doi:10.1038/s41591-018-0049-z.
- 7 Kosicki, Michael, Kärt Tomberg, and Allan Bradley. "Repair of Double-Strand Breaks Induced by CRISPR-Cas9 Leads to Large Deletions and Complex Rearrangements." *Nature*

Biotechnology 36 (July 16, 2018): 765–771. https://www.researchgate.net/publication/326429946_Repair_of_double-strand_breaks_induced_by_CRISPR-Cas9_leads_to_large_deletions_and_complex_rearrangements. Cena deonica kompanija povezanih sa CRISPR tehnologijom redovno opadne kad se pojavi neki ovakav izveštaj. Na dan objavljivanja ovog članka, CRISPR Therapeutics, Editas Medicine, i Intellia Therapeutics pretrpeli su gubitak od ukupno 300 miliona dolara u vrednosti deonica.

- 8 Emily Mullin, "CRISPR 2.0 Is Here, and It's Way More Precise," *MIT Technology Review*, October 25, 2017, <https://www.technologyreview.com/s/609203/crispr-20-is-here-and-its-way-more-precise/>.
- 9 Ibid.
- 10 Nicole M. Gaudelli et al., "Programmable Base Editing of A•T to G•C in Genomic DNA without DNA Cleavage," *Nature* 551 (2017): 464–471, <http://evolve.harvard.edu/138-ABE.pdf>.
- 11 Yanting Zeng et al., "Correction of the Marfan Syndrome Pathogenic FBN1 Mutation by Base Editing in Human Cells and Heterozygous Embryos," *Molecular Therapy*, August 13, 2018. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6224777/>.
- 12 Michael Gapinske et al., "CRISPR-SKIP: Programmable Gene Splicing with Single Base Editors," *Genome Biology* 19, no. 1 (2018). <https://genomebiology.biomedcentral.com/articles/10.1186/s13059-018-1482-5>.
- 13 Cassandra Willyard, "The Epigenome Editors: How Tools Such as CRISPR Offer New Details about Epigenetics," *Nature Medicine* 23, no. 8 (2017): 900–03, doi:10.1038/nm0817-900; Ianis G. Matsoukas, "Commentary: RNA Editing with CRISPR-Cas13," *Frontiers in Genetics* 9 (2018), <https://www.frontiersin.org/articles/10.3389/fgene.2018.00134/full>.
- 14 Zhuchi Tu et al., "Promoting Cas9 Degradation Reduces Mosaic Mutations in Non-Human Primate Embryos," *Scientific Reports* 7 (2017), <https://www.nature.com/articles/srep42081>; Michael Le Page, "Mosaic Problem Stands in the Way of Gene

- Editing Embryos,” New Scientist, March 15, 2017, <https://www.newscientist.com/article/mg23331174-400-mosaic-problem-stands-in-the-way-of-gene-editing-embryos/>; P. Singh, J. C. Schimenti, and E. Bolcun-Filas, “A Mouse Geneticist’s Practical Guide to CRISPR Applications,” *Genetics* 199 (2014): 1–15, <http://www.genetics.org/content/199/1/1.full>; Michael Le Page, “Male Infertility Cure Will Be Gateway to Editing Our Kids’ Genes,” New Scientist, June 23, 2016, <https://www.newscientist.com/article/2094926-male-infertility-cure-will-be-gateway-to-editing-our-kids'-genes/>.
- 15 Hong Ma et al., “Correction of a Pathogenic Gene Mutation in Human Embryos,” *Nature* 548 (2017): 413–419, <https://www.nature.com/articles/nature23305>.
 - 16 Dieter Egli et al., “Inter-homologue Repair in Fertilized Human Eggs?” *BioRxiv* (2017), <https://www.biorxiv.org/content/10.1101/181255v1>.
 - 17 Adikusuma, Fatwa, Sandra Piltz, Mark A. Corbett, Michelle Turvey, Shaun R. Mccoll, Karla J. Helbig, Michael R. Beard, James Hughes, Richard T. Pomerantz, and Paul Q. Thomas. “Large Deletions Induced by Cas9 Cleavage,” *Nature* 560, no. 7,717 (2018). doi:10.1038/s41586-018-0380-z; Dieter Egli, et al. “Inter-homologue Repair in Fertilized Human Eggs?” *Nature* 560 (2018); Fatwa Adikusuma et al., “Large Deletions Induced by Cas9 Cleavage,” *Nature* 560 (August 2018): E8–E9, <https://www.nature.com/articles/s41586-018-0380-z>.
 - 18 Genome Editing and Human Reproduction. Report. July 17, 2018, Nuffield Council on Bioethics. <http://nuffieldbioethics.org/wp-content/uploads/Genome-editing-and-human-reproduction-FINALwebsite.pdf>, p. 45.
 - 19 Dennis Normile, “CRISPR Bombshell: Chinese Researcher Claims to Have Created Gene-Edited Twins,” *Science*, November 26, 2018, <https://www.sciencemag.org/news/2018/11/crispr-bombshell-chinese-researcher-claims-have-created-gene-edited-twins>.
 - 20 Jacob Gratten and Peter M. Visscher, “Genetic Pleiotropy in Complex Traits and Diseases: Implications for Genomic

- Medicine,” *Genome Medicine* 8 (2016), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4952057/>.
- 21 Evan A. Boyle et al., “An Expanded View of Complex Traits: From Polygenic to Omnipotent,” *Cell* 169 (2017): 1177–1186, [http://www.cell.com/cell/fulltext/S0092-8674\(17\)30629-3](http://www.cell.com/cell/fulltext/S0092-8674(17)30629-3).
 - 22 The omnipotent hypothesis remains controversial and has been hotly debated by scientists since the publication of the 2017 Boyle and Li article in Cell. Vid. “The Omnipotent Model: Special Issue,” *Journal of Psychiatry and Brain Science* 2, no. 5 (2017). https://jpbs.hapres.com/htmls/JPBS_923_Detail.html, i Naomi Wray et al., “Common Disease Is More Complex Than Implied by the Core Gene Omnipotent Model,” *Cell* 173, no. 7 (June 14, 2018): 1573–1580, [https://www.cell.com/cell/comments/S0092-8674\(18\)30714-1](https://www.cell.com/cell/comments/S0092-8674(18)30714-1).
 - 23 Nadam se da čete posetiti vebajt ovog neverovatnog projekta: <http://www.openworm.org/>. Takođe vid. <http://bioloska.blogspot.com/2012/10/projekat-open-worm-kreiranje-prve.html>.
 - 24 Lucy Black, “A Worm’s Mind in a Lego Body,” I Programmer, November 16, 2014, <http://www.iprogrammer.info/news/105-artificial-intelligence/7985-a-worms-mind-in-a-lego-body.html#>; https://www.youtube.com/watch?v=_CfxbqbfZ_k.
 - 25 Human Cell Atlas, <https://www.humancellatlas.org/>.
 - 26 Ray Kurzweil, “The Law of Accelerating Returns,” Kurzweil Accelerating Intelligence, March 7, 2001, <http://www.kurzweilai.net/the-law-of-accelerating-returns>; https://www.slobodnaevropa.org/a/svijet_nauka_tehnologija/1837118.html.
 - 27 Ray Kurzweil, *The Singularity Is Near: When Humans Transcend Biology* (London: Duckworth, 2016): 39. Za divno objašnjenje, vid. i Tim Urban, “The Artificial Intelligence Revolution: The Road to Superintelligence,” Wait But Why, January 22, 2015, <https://waitbutwhy.com/2015/01/artificial-intelligence-revolution-1.html>.
 - 28 Homer, Ilijada, VI, 3, 180 (Dereta, Beograd, 2004; prev. Miloš N. Đurić). (Prim. prev.)

- 29 Dante Aligijeri, Pakao (Zavod za udžbenike i nastavna sredstva, Beograd, 1998; prev. Dragan Mraović). (Prim. prev.)
- 30 Catherine Easterbrook and Guy Maddern, “Porcine and Bovine Surgical Products: Jewish, Muslim, and Hindu Perspectives,” *JAMA* 143 (2008): 366–370, <https://jamanetwork.com/journals/jamasurgery/fullarticle/599037>.
- 31 Simon Bramhall, “Presumed Consent for Organ Donation: A Case Against,” *Annals of the Royal College of Surgeons of England* 93 (2011): 270–272, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3363073/>. Pajtonovci su 1983. snimili Smisao života (Monty Python’s The Meaning of Life), urnebesnu parodiju na temu “transplantiranja živilih organa”, <https://www.youtube.com/watch?v=5ig9wr8517E>.
- 32 Promene propisa, poput prelaska na sistem „opt-out“ sa sistema „opt-in“ za doniranje organa (tj. da se svi smatraju donorima organa sem ukoliko se ne izjasne drugačije) ili ozakonjenje kompenzovanja porodica donora moglo bi pomoći da se ovaj nedostatak ublaži. “Organ Donation Statistics,” U.S. Department of Health and Human Services, <https://www.organdonor.gov/statistics-stories/statistics.html>.
- 33 Bethany Pellegrino, “Immunosuppression,” Medscape, last modified January 4, 2016, <https://emedicine.medscape.com/article/432316-overview#a2>.
- 34 Li Wei et al., “Inactivation of Porcine Endogenous Retrovirus in Pigs Using CRISPR-Cas9,” *Science*, September 22, 2017. <http://science.sciencemag.org/content/357/6357/1303>.
- 35 Nicola Davis, “Breakthrough as Scientists Grow Sheep Embryos Containing Human Cells,” *The Guardian*, February 17, 2018, <https://www.theguardian.com/science/2018/feb/17/breakthrough-as-scientists-grow-sheep-embryos-containing-human-cells>.
- 36 Registry of Standard Biological Parts, http://parts.igem.org/Main_Page.
- 37 The Free Genes Project, <https://biobricks.org/freegenes/>.
- 38 Onkar Sumant, “Synthetic Biology Market by Products (DNA Synthesis, Oligonucleotide Synthesis, Synthetic DNA, Synthetic

- Genes, Synthetic Cells, XNA) and Technology (Genome Engineering, Microfluidics Technologies, DNA Synthesis & Sequencing Technologies): Global Opportunity Analysis and Industry Forecast, 2013–2020,” March 2014, <https://www.alliedmarketresearch.com/synthetic-biology-market>; “The Global Synthetic Biology Market Is Projected to Grow at a CAGR of 19.9%,” PR Newswire, January 5, 2018, <https://www.prnewswire.com/news-releases/the-global-synthetic-biology-market-is-projected-to-grow-at-a-cagr-of-199-300578132.html>.
- 39 Steven Cerier, “Synthetic Biology’s ‘Promise and Potential’ Capture Investor Attention.” Genetic Literacy Project, May 8, 2018, accessed May 8, 2018, https://geneticliteracyproject.org/2018/05/08/synthetic-biology-s-promise-potential-investor-attention/?mc_cid=9b36f13d19&mc_eid=6d7f502b6d.
- 40 Robert F. Service, “Synthetic Microbe Lives with Fewer Than 500 Genes,” *Science*, December 9, 2017, accessed May 8, 2018, <http://www.sciencemag.org/news/2016/03/synthetic-microbe-lives-fewer-500-genes>.
- 41 David Ewing Duncan, “Is the World Ready for Synthetic People?” NeoLife, April 5, 2018, accessed April 22, 2018, <https://medium.com/neodotlife/q-a-with-drew-endy-bde0950fd038>. Vid. i George M. Church and Edward Regis, *Regenesis: How Synthetic Biology Will Reinvent Nature and Ourselves* (New York: Basic Books, 2014): 53.
- 42 Veoma je važno to što su naučnici koji sarađuju na ovom projektu naglasili etička pitanja ove inicijative. Jef D. Boeke et al., “The Genome Project-Write,” *Science* 353 no. 6295 (July 8, 2016): 126–127, <http://science.sciencemag.org/content/353/6295/126>.
- 43 David Ewing Duncan, “The Next Best Version of Me: How to Live Forever,” *Wired*, March 27, 2018, <https://www.wired.com/story/live-forever-synthetic-human-genome/>.
- 44 The Mason Lab, <http://www.masonlab.net/>.

Sedmo poglavlje

Ukrasti bogovima besmrtnost

- 1 Gilgameš, sumersko/vavilonski ep (Knjiga-komerc, Beograd, 1994.). (Prim. prev.)
- 2 Eric Grundhauser, “The True Story of Dr. Voronoff’s Plan to Use Monkey Testicles to Make Us Immortal,” *Atlas Obscura*, October 13, 2015, <https://www.atlasobscura.com/articles/the-true-story-of-dr-voronoffs-plan-to-use-monkey-testicles-to-make-us-immortal>.
- 3 Renee Stepler, “World’s Centenarian Population Projected to Grow Eightfold by 2050,” Pew Research Center, April 21, 2016, <http://www.pewresearch.org/fact-tank/2016/04/21/worlds-centenarianpopulation-projected-to-grow-eightfold-by-2050/>.
- 4 “Living to 120 and Beyond: Americans’ Views on Aging, Medical Advances and Radical Life Extension,” Pew Research Center, August 6, 2013, <http://www.pewforum.org/2013/08/06/living-to-120-and-beyond-americans-views-on-aging-medical-advances-and-radical-life-extension/>.
- 5 Xian Xia et al., “Molecular and Phenotypic Biomarkers of Aging,” *F1000 Research* 6 (2017), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5473407/>.
- 6 Carola Weidner, “Aging of Blood Can Be Tracked by DNA Methylation Changes at Just Three CpG Sites,” *Genome Biology* 15 (2014), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4053864/pdf/gb-2014-15-2-r24.pdf>. Zanimljivo je da se ispostavilo kako gen p53 igra i važnu ulogu u borbi protiv kancera u slonova. Vid. Carl Zimmer, “The ‘Zombie Gene’ That May Protect Elephants from Cancer,” *New York Times*, August 14, 2018, <https://www.nytimes.com/2018/08/14/science/the-zombiegene-that-may-protect-elephants-from-cancer.html>.
- 7 Masayuki Kimura et al., “Telomere Length and Mortality: A Study of Leukocytes in Elderly Danish Twins,” *American Journal of Epidemiology* 167 (2008): 799–806, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3631778/>

- 8 F. Huber et al., “Walking Speed as an Aging Biomarker in Baboons (*Papio Hamadryas*).” *Journal of Medical Primatology*, U.S. National Library of Medicine (December 2015), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4802968/>.
- 9 Weiyang Chen et al., “Three-Dimensional Human Facial Morphologies as Robust Aging Markers,” *Cell Research* 25, no. 5 (May 2015): 574–587, accessed April 28, 2018, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4423077/>.
- 10 A group of revisionist anthropologists recently made the case that grandmothers in particular play a more important evolutionary role than previously imagined. Matthew H. Chan, Kristen Hawkes, and Peter S. Kim. “Modelling the Evolution of Traits in a Two-Sex Population, with an Application to Grandmothering,” *Bulletin of Mathematical Biology* 79, no. 9 (2017): 2132–148, doi:10.1007/s11538-017-0323-0.
- 11 Julie A. Mattison et al., “Caloric Restriction Improves Health and Survival of Rhesus Monkeys,” *Nature Communications* 8 (2017), <https://www.nature.com/articles/ncomms14063>. Premda je u prvi mah izgledalo kao da jedna studija pokazuje da CR deluje produžavajući životni vek i poboljšavajući zdravlje majmuna, a druga ne, naknadna kritička procena podataka potvrdila je da su obe studije urodile istim rezultatom.
- 12 Leanne M. Redman et al., “Metabolic Slowing and Reduced Oxidative Damage with Sustained Caloric Restriction Support the Rate of Living and Oxidative Damage Theories of Aging,” *Cell Metabolism* 27 (2018): 1–11, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5886711/>.
- 13 These chronic diseases account for over 90 percent of all deaths in the United States. Ove hronične bolesti odgovorne su za gotovo devedeset odsto smrtnih slučajeva u Sjedinjenim Državama. Khadija Ismail et al., “Compression of Morbidity Is Observed Across Cohorts with Exceptional Longevity,” *Journal of the American Geriatrics Society* 64 (2016): 1583–1591, <https://www.ncbi.nlm.nih.gov/pubmed/27377170>.
- 14 “Wellderly Study Suggests Link Between Genes That Protect against Cognitive Decline and Overall Healthy Aging,” *The*

- Scripps Research Institute, April 21, 2016, <https://www.scripps.edu/news/press/2016/20160421wellderly.html>; Galina A. Erikson et al., "Whole-Genome Sequencing of a Healthy Aging Cohort," *Cell* 165 (2016): 1002–1011, [http://www.cell.com/cell/fulltext/S0092-8674\(16\)30278-1](http://www.cell.com/cell/fulltext/S0092-8674(16)30278-1).
- 15 Freudenberg-Hua et al., "Disease Variants in Genomes of 44 Centenarians," *Molecular Genetics and Genomic Medicine* 2 (2014): 438–450, <https://www.ncbi.nlm.nih.gov/pubmed/25333069>.
 - 16 Clyde B. Schechter et al., "Cholesteryl Ester Transfer Protein (CETP) Genotype and Reduced CETP Levels Associated with Decreased Prevalence of Hypertension," *Mayo Clinic Proceedings* 85 (2010): 522–526, <https://www.ncbi.nlm.nih.gov/pubmed/20511482>.
 - 17 Nir Barzilai and Ilan Gabriely, "Genetic Studies Reveal the Role of the Endocrine and Metabolic Systems in Aging," *The Journal of Clinical Endocrinology & Metabolism* 95 (2010): 4493–4500, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3050096/>.
 - 18 Galina A. Erikson et al., "Whole-Genome Sequencing of a Healthy Aging Cohort," *Cell* 165 (2016): 1002–1011, [http://www.cell.com/cell/fulltext/S0092-8674\(16\)30278-1](http://www.cell.com/cell/fulltext/S0092-8674(16)30278-1).
 - 19 Luke C. Pilling et al., "Human Longevity: 25 Genetic Loci Associated in 389,166 UK Biobank Participants," *Aging* 9 (2017): 2504–2520, <http://www.aging-us.com/article/101334/text#fulltext>.
 - 20 Dan Buettner, *The Blue Zones: Lessons for Living Longer from the People Who've Lived the Longest* (National Geographic Books, 2009): vii. Vid. i <https://www.nationalgeographic.com/news/2015/04/150412-longevity-health-blue-zones-obesity-diet-ngbooktalk/>.
 - 21 R. Speakman, "Body Size, Energy Metabolism and Life Span," *Journal of Experimental Biology* 208 (2005): 1717–1730, <https://www.ncbi.nlm.nih.gov/pubmed/15855403>.
 - 22 Antonio Regaldo, "Google's Long, Strange, Life Span Trip," *MIT Technology Review*, December 15,

- 2016, <https://www.technologyreview.com/s/603087/googles-long-strange-life-span-trip/>.
- 23 Karl A. Rodriguez et al., "Determinants of Rodent Longevity in the Chaperone-protein Degradation Network," *Cell Stress and Chaperones* 21, no. 3 (2016): 453–66. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4837185/>.
 - 24 Jorge Azpurua et al., "Naked Mole-Rat Has Increased Translational Fidelity Compared with the Mouse, as well as a Unique 28S Ribosomal RNA Cleavage," *Proceedings of the National Academy of Sciences of the United States of America* 110 (2013): 17350–17355, <http://www.pnas.org/content/110/43/17350>.
 - 25 Joseph Stromberg, "Why Do Naked Mole Rats Live So Long?" *Smithsonian.com*, September 30, 2013, <https://www.smithsonianmag.com/science-nature/why-do-naked-mole-rats-live-so-long-230258/>.
 - 26 Ungvari et al., "Extreme Longevity Is Associated with Increased Resistance to Oxidative Stress in *Arctica islandica*, the Longest-Living Non-Colonial Animal," *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences* 66A (2011): 741–750, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3143345/>.
 - 27 Piraino et al., "Reversing the Life Cycle: Medusae Transforming into Polyps and Cell Transdifferentiation in *Turritopsis nutricula* (Cnidaria, Hydrozoa)," *The Biological Bulletin* 190 (1996): 302–312, https://www.jstor.org/stable/1543022?seq=1#page_scan_tab_contents.
 - 28 Za fenomenalan prikaz načina na koji naučnici proučavaju razne dugovečne jednostavne organizme, vid. Ronald S. Petralia, Mark P. Mattson, and Pamela J. Yao, "Aging and Longevity in the Simplest Animals and the Quest for Immortality," *Ageing Research Reviews* 16 (2014): 66–82, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4133289/>.
 - 29 Mutacija na genu Daf-2 pomogla je valjkastim crvima da žive dvostruko duže od svojih sunarodnika bez mutacije. Mutacija na genu Daf-16 imala je suprotan efekat. Važno je, međutim,

- napomenuti da su mutacije koje su produžavale život imale i bitne nuspojave, među kojima su smanjena plodnost, manja veličina i ponekad veće šanse za smrt in utero. Cynthia J. Kenyon, "The Genetics of Ageing," *Nature* 464 (2010): 504–512, <https://www.nature.com/articles/nature08980>; Masaharu Uno and Eisuke Nishida, "Life Span-Regulating Genes in *C. elegans*," *Aging and Mechanisms of Disease* 2 (2016); "Caenorhabditis Elegans," AnAge: The Animal Ageing and Longevity Database, http://genomics.senescence.info/species/entry.php?species=Caenorhabditis_Elegans; David Michaelson et al., "Insulin Signaling Promotes Germline Proliferation in *C. elegans*," *Development*, February 15, 2010, accessed May 12, 2018, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2827619/>.
- 30 Elizabeth H. Blackburn and Elissa Epel, *The Telomere Effect: A Revolutionary Approach to Living Younger, Healthier, Longer* (London: Orion Spring, 2018). See also my conversation with Nobel laureate and telomere pioneer Elizabeth Blackburn (and Harvard geneticist George Church) at the 2017 Google Zeitgeist conference, *Zeitgeistminds*, "Unlocking the Code of Life," YouTube, October 24, 2017, accessed May 25, 2018, <https://www.youtube.com/watch?v=srX79RA-HPQ&feature=youtu.be>.
- 31 Wei et al., "Fasting-Mimicking Diet and Markers/Risk Factors for Aging, Diabetes, Cancer, and Cardiovascular Disease," *Science Translational Medicine* 9 (2017), <http://stm.sciencemag.org/content/9/377/eaai8700.short>.
- 32 Steven C. Moore et al., "Leisure Time Physical Activity of Moderate to Vigorous Intensity and Mortality: A Large Pooled Cohort Analysis," *PLOS Medicine* 9 (2012), <http://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1001335>.
- 33 Michael S. Bonkowski and David A. Sinclair, "Slowing Ageing by Design: The Rise of NAD and Sirtuin-Activating Compounds," *Nature Reviews Molecular Cell Biology* 17 (2016): 679–690, <https://www.nature.com/articles/nrm.2016.93>; Abhirup Das et al., "Impairment of an Endothelial NAD-H 2 S Signaling Network Is a Reversible Cause of Vascular Aging," *Cell* 173 (2018): 74–89.

- 34 M. Evans et al., "Metformin and Reduced Risk of Cancer in Diabetic Patients," *BMJ* 330 (2005): 1304–1305, <https://www.ncbi.nlm.nih.gov/pubmed/15849206>.
- 35 A. Bannister et al., "Can People with Type 2 Diabetes Live Longer Than Those Without? A Comparison of Mortality in People Initiated with Metformin or Sulphonylurea Monotherapy and Matched, Non-Diabetic Controls," *Diabetes, Obesity and Metabolism* 16 (2014): 1165–1173, <http://onlinelibrary.wiley.com/doi/10.1111/dom.12354/full>.
- 36 P. Ng et al., "Long-Term Metformin Usage and Cognitive Function among Older Adults with Diabetes," *Journal of Alzheimer's Disease* 41 (2014): 61–68, <https://www.ncbi.nlm.nih.gov/pubmed/24577463>; V. N. Anisimov, "Metformin for Cancer and Aging Prevention: Is It a *Time* to Make the Long Story Short?" *Oncotarget*. November 24, 2015, accessed April 28, 2018, <https://www.ncbi.nlm.nih.gov/pubmed/26583576>. Rezultati nekih drugih studija govore o manjem pozitivnom uticaju metmorfina.
- 37 Alejandro Martin-Montalvo, "Metformin Improves Healthspan and Life Span in Mice," *Nature Communications* 4 (2013), <https://www.nature.com/articles/ncomms3192>.
- 38 Jing Li, Sang Gyun Kim, and John Blenis, "Rapamycin: One Drug, Many Effects," *Cell Metabolism* 19 (2014): 373–379, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3972801/>.
- 39 Simon C. Johnson, Peter S. Rabinovitch, and Matt Kaeberlein, "MTOR Is a Key Modulator of Ageing and Age-Related Disease," *Nature* 493 (2013): 338–345, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3687363/>.
- 40 Dog Aging Project, accessed June 18, 2018, <http://dogaging-project.com/>. Silvan R. Urfer et al., "A Randomized Controlled Trial to Establish Effects of Short-Term Rapamycin Treatment in 24 Middle-Aged Companion Dogs," *GeroScience* 39, no. 2 (2017): 117–27. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5411365/>; Matt Kaeberlein, Kate E. Creevy, and Daniel E. L. Promislow, "The Dog Aging Project: Translational Geroscience in Companion Animals," *Mammalian Genome* 27,

- no. 7–8 (2016): 279–88, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4936929/>.
- 41 Simon C. Johnson, Peter S. Rabinovitch, and Matt Kaeberlein, “MTOR Is a Key Modulator of Ageing and Age-Related Disease,” *Nature* 493 (2013): 338–345, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3687363/>.
- 42 Simon C. Johnson and Matt Kaeberlein, “Rapamycin in Aging and Disease: Maximizing Efficacy While Minimizing Side Effects,” *Oncotarget* 7 (2016): 44876–44878, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5216691/>; V. N. Anisimov, “Metformin for Cancer and Aging Prevention: Is It a *Time* to Make the Long Story Short?” *Oncotarget* November 24, 2015, accessed April 28, 2018, <https://www.ncbi.nlm.nih.gov/pubmed/26583576>.
- 43 Serija novijih studija mševa pokazuje u pravcu mogućeg načina delovanja ovog tipa koktela. U jednoj je metformin produžio životni vek miševa za prosečno sedam odsto, ali miševi koji su dobijali i metformin i rapamicin bili su najdugovečniji od svih proučavanih miševa. Ženke kojima je davan isključivo rapamicin živele su od osamnaest do dvadeset pet odsto duže u odnosu na one koje nisu dobijale nikakav lek, ali životni vek ženki kojima je davana mešavina rapamicina i metmorfina bio je duži za dvadeset tri odsto. Samo rapamicin produžavao je vek mužjacima za deset do trinaest procenata, dok ga je kombinacija rapamicina i metmorfina produžavala za dvadeset tri procenata. L. J. Wei, D. Y. Lin, and L. Weissfeld, “Regression Analysis of Multivariate Incomplete Failure *Time* Data by Modeling Marginal Distributions,” *Journal of the American Statistical Association* 84 (1989): 1065, <http://dlin.web.unc.edu/files/2013/04/WeiLinWeissfeld89.pdf>.
- 44 Abel Soto-Gamez and Marco Demaria, “Therapeutic Interventions for Aging: The Case of Cellular Senescence,” *Drug Discovery Today* 22 (2017): 786–795, <http://www.sciencedirect.com/science/article/pii/S135964461730017X>.
- 45 Eva Latorre et al., “Mitochondria-Targeted Hydrogen Sulfide Attenuates Endothelial Senescence by Selective Induction of

- Splicing Factors HNRNPD and SRSF2,” *Aging*, August 19, 2018, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6075431/>.
- 46 P. Baar et al., “Target Apoptosis of Senescent Cells Restores Tissue Homeostasis in Response to Chemotoxicity and Aging,” *Cell* 169 (2017): 132–147, <https://www.ncbi.nlm.nih.gov/pubmed/28340339>.
- 47 Alejandro Ocampo, “In Vivo Amelioration of Age-Associated Hallmarks by Partial Reprogramming,” *Cell* 167 (2016): 1719–1733, [http://www.cell.com/cell/fulltext/S0092-8674\(16\)31664-6](http://www.cell.com/cell/fulltext/S0092-8674(16)31664-6).
- 48 “Turning Back *Time*: Salk Scientists Reverse Signs of Aging,” The Salk Institute, December 15, 2016, <https://www.salk.edu/news-release/turning-back-time-salk-scientists-reverse-signs-aging/>.
- 49 M. Conboy, “Rejuvenation of Aged Progenitor Cells by Exposure to a Young Systemic Environment,” *Nature* 433 (2005): 760–764, <https://www.ncbi.nlm.nih.gov/pubmed/15716955>.
- 50 Jocelyn Kaiser, “Young Blood Renews Old Mice,” *Science*, May 4, 2014, <http://www.sciencemag.org/news/2014/05/young-blood-renews-old-mice>.
- 51 “Longevity Industry Landscape Overview 2017,” *Geroscience, Policy, and Economics*, p. 7, <https://inovaconsulting.com.br/wp-content/uploads/2018/07/LONGEVITY-INDUSTRY-LANDSCAPE-OVERVIEW-2017.compressed.pdf>.
- 52 P. Goldman et al., “Substantial Health And Economic Returns from Delayed Aging May Warrant A New Focus for Medical Research,” *Health Affairs* 32 (2013): 1698–1705, <https://www.healthaffairs.org/doi/full/10.1377/hlthaff.2013.0052>; <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3938188/>.

Osmo poglavlje

Etika samoinženjeringa

- 1 Andrew Hammond et al., “A CRISPR-Cas9 Gene Drive System Targeting Female Reproduction in the Malaria Mosquito Vector *Anopheles gambiae*,” *Nature Biotechnology* 34 (2016): 78–83, <https://www.nature.com/articles/nbt.3439>. Za dobar opis genetskih drajvova, vid. “FAQs: Gene Drives,” Wyss Institute, Harvard University, accessed May 12, 2018, [https://wyss.harvard.edu/staticfiles/newsroom/pressreleases/Gene drives FAQ FINAL.pdf](https://wyss.harvard.edu/staticfiles/newsroom/pressreleases/Gene%20drives%20FAQ_FINAL.pdf).
- 2 There Was an Old Lady Who Swallowed a Fly, stara dečja pesmica nepoznatog autora; konačnu verziju stihova i muzike zaštitili su 1952 .Rose Bonne i Alan Mills.
- 3 Human Dignity and Bioethics: Essays Commissioned by the President’s Council on Bioethics (Washington, DC: March 2008): 329, https://bioethicsarchive.georgetown.edu/pcbe/reports/human_dignity/.
- 4 Michael J. Sandel, “The Case Against Perfection,” *The Atlantic*, April 2014, <https://www.theatlantic.com/magazine/archive/2004/04/the-case-against-perfection/302927/>.
- 5 Iz Pisma J.D. Hookera, od 13. jula 1856, Darwin Correspondence Project, [https://www.darwinproject.ac.uk/letter/?docId=letters/DCP-LETT-1924.xml;query=13%20July%20\[1856\];brand=default](https://www.darwinproject.ac.uk/letter/?docId=letters/DCP-LETT-1924.xml;query=13%20July%20[1856];brand=default).
- 6 Marcy Darnovsky, “A Slippery Slope to Human Germline Modification,” *Nature* 499, no. 7457 (July 9, 2013): 127, <http://www.nature.com/news/a-slippery-slope-to-human-germline-modification-1.13358>.
- 7 César Palacios-González, John Harris, and Giuseppe Testa, “Multiplex Parenting: IVG and the Generations to Come,” *Journal of Medical Ethics* 40 (March 7, 2014): 752–758, <http://jme.bmjjournals.org/content/early/2014/03/07/medethics-2013-101810>.

- 8 Sidarta Mukardži, Gen: Intimna istorija (Laguna, Beograd, 2018).
- 9 Julian Savulescu and Guy Kahane, “The Moral Obligation to Create Children with the Best Chance of the Best Life,” *Bioethics* 23, no. 5 (2009): 274–290, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2990364/>.
- 10 Nick Bostrom and Toby Ord, “How to Avoid Status Quo Bias in Bioethics: The Case for Human Enhancement,” 2004, <https://nickbostrom.com/ethics/statusquo.doc>.
- 11 Carl Zimmer, She Has Her Mother’s Laugh: The Powers, Perversions, and Potential of Heredity (New York: Dutton, 2018).
- 12 Rebecca Bennett, “When Intuition Is Not Enough. Why the Principle of Procreative Beneficence Must Work Much Harder to Justify Its Eugenic Vision,” *Bioethics* 28 (July 10, 2013): 447–455, <http://onlinelibrary.wiley.com/doi/10.1111/bioe.12044/full>; Biplob Kumar Halder, “Can the Principle of Procreative Beneficence Justify the Non-Medical Use of Preimplantation Genetic Diagnosis?” Center for the Study of Ethics in Society Papers, Paper 103 (2016), http://scholarworks.wmich.edu/cgi/viewcontent.cgi?article=1101&context=ethics_papers.
- 13 “The Laws of the Twelve Tables,” c. 450 B.C.E., <https://facultystaff.richmond.edu/~wstevens/FYSTexts/twelvetables.pdf>. Vid. i https://sr.wikisource.org/sr-el/Закон_дванаест_таблица.
- 14 Francis Galton, Inquiries into the Human Faculty and Its Development (Macmillan, 1883): 24.
- 15 The Eugenics Review 1, no. 1 (April 1909). <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2990364/>?page=1. Ovaj žurnal prestao je da izlazi tek 1968. godine.
- 16 George F. Will, “The Liberals Who Loved Eugenics,” *Washington Post*, March 8, 2017, https://www.washingtonpost.com/opinions/the-liberals-who-loved-eugenics/2017/03/08/0cc5e9a0-0362-11e7-b9fa-ed727b644a0b_story.html?utm_term=.5758cd0c98e3.
- 17 Henry Fairfield Osborn, Collected Papers (1877): Volume 4, p. 2., <https://books.google.cd/>

- [books?id=jXQuAAAAIAAJ&printsec=frontcover&hl=fr&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2757926/).
- 18 Steven A. Farber, "U.S. Scientists' Role in the Eugenics Movement (1907–1939): A Contemporary Biologist's Perspective," *Zebrafish* 5, no. 4 (December 2008): 243–245, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2757926/>.
- 19 Za spisak materijala o krajnje nečuvenom slučaju Portorika, vid. "Sterilization of Puerto Rican Women: A Selected, Partially Annotated Bibliography (Louis de Malave, 1999)" Special Collections, March 23, 2018, accessed June 26, 2018, <https://www.library.wisc.edu/gwslibrarian/publications/bibliographies/sterilization/>.
- 20 Paul A. Lombardo, "Three Generations, No Imbeciles: New Light on Buck v. Bell," *NYU Law Review* 80 (1985): 30–62, <https://pdfs.semanticscholar.org/784b/f1b7cfbbc84b6966f4c3b0f3d554726d551e.pdf>.
- 21 Adolph Hitler, *Mein Kampf* (1925): 222–223, trans. Ralph Manheim (Boston: Houghton Mifflin Company, 1999). <http://www.sjsu.edu/people/mary.pickering/courses/His146/s1/MeinKampfpartone0001.pdf>.
- 22 Charles J. Epstein, "Is Modern Genetics the New Eugenics?" *Genetics in Medicine* 5 (2003): 469–475, <https://www.nature.com/articles/gim2003376>.
- 23 Michael J. Sandel, "The Case against Perfection," *The Atlantic*, April 2004, <https://www.theatlantic.com/magazine/archive/2004/04/the-case-against-perfection/302927/>.
- 24 Arthur Kaplan, "What Should the Rules Be?" *Time*, January 14, 2001, <http://content.time.com/time/magazine/article/0,9171,95244,00.html>.
- 25 Richard Dawkins, *The Genetic Revolution and Human Rights*, ed. Justine Burley (Oxford: Oxford University Press, 1999): v–xviii; cited in Charles J. Epstein, "Is Modern Genetics the New Eugenics?" *Nature*, November 1, 2003, accessed May 10, 2018, <https://www.nature.com/articles/gim2003376>.

- 26 Diane B. Paul, *The Politics of Heredity: Essays on Eugenics, Biomedicine, and the Nature-Nurture Debate* (New York: State University of NY Press, 1998) p. 97; citat u Charles J. Epstein, "Is Modern Genetics the New Eugenics?" *Nature*, November 1, 2003, accessed May 10, 2018, <https://www.nature.com/articles/gim2003376>.
- 27 Jon Entine, "Let's (Cautiously) Celebrate the 'New Eugenics,'" *Huffington Post*, October 30, 2014, https://www.huffingtonpost.com/jon-entine/lets-cautiously-celebrate_b_6070462.html.
- 28 Nicholas Agar, *Liberal Eugenics: In Defense of Human Enhancement* (Oxford: Blackwell, 2004): vi, 5. Nicholas Agar, "Liberal Eugenics," *Public Affairs Quarterly* 12 (1998): 137–155, <https://writingbio.qwriting.qc.cuny.edu/files/2011/08/agar.pdf>.
- 29 Adam Cohen, "Is There Such a Thing as Good Eugenics?" *Los Angeles Times*, March 17, 2017, <http://www.latimes.com/opinion/op-ed/la-oe-cohen-good-eugenics-20170317-story.html>.
- 30 Stephen Whyte, Benno Torgler, and Keith L. Harrison, "What Women Want in Their Sperm Donor: A Study of More Than 1000 Women's Sperm Donor Selections," *Economics & Human Biology* 23 (2016): 1–9, <https://www.ncbi.nlm.nih.gov/pubmed/27359087>.
- 31 Shana Lebowitz, "Science Says Being Tall Could Make You Richer and More Successful—Here's Why," *Business Insider*, September 9, 2015, <http://www.businessinsider.com/tall-people-are-richer-and-successful-2015-9>; Roger Highfield, "Symmetrical Human Faces Are More Beautiful," *The Telegraph*, June 5, 2008, <http://www.telegraph.co.uk/news/science/science-news/3343640/Symmetrical-human-faces-are-more-beautiful.html>.
- 32 R. Sanders et al., "Genome-wide Scan Demonstrates Significant Linkage for Male Sexual Orientation," *Psychological Medicine* 45 (2014): 1379–1388; https://www.researchgate.net/publication/268392254_Genome-wide_scan_demonstrates_significant_linkage_for_male_sexual_orientation; Siddhartha Mukherjee, *The Gene: An Intimate History* (London: Vintage,

- 2017): 373–379; vid. i Sidarta Mukardži, Gen: Intimna istorija, (Laguna, Beograd, 2018).
- 33 Nicholas G. Crawford et al., “Loci Associated with Skin Pigmentation Identified in African Populations,” *Science Magazine* 17 (2017), <https://www.ncbi.nlm.nih.gov/pubmed/29025994>.
- 34 Kenta Watanabe et al., “CRISPR/Cas9-Mediated Mutagenesis of the Dihydroflavonol-4-reductase-B (DFR-B) Locus in the Japanese Morning Glory Ipomoea (Pharbitis) Nil,” *Scientific Reports* 7 (August 30, 2017), <http://bio-engineering.ir/wp-content/uploads/2017/10/s41598-017-10715-1.pdf>.
- 35 “Study Finds Autistics Better at Problem-Solving,” EurekAlert!, June 16, 2009, https://www.eurekalert.org/pub_releases/2009-06/uom-sfa061609.php. Vid. i <https://www.bbc.com-serbian/lat/svet-47391540>.
- 36 Neel Burton, “Bipolar Disorder and Creativity,” *Psychology Today*, March 9, 2012, <https://www.psychologytoday.com/blog/hide-and-seek/201203/bipolar-disorder-and-creativity>.
- 37 Elizabeth Theusch, Analabha Basu, and Jane Gitschier, “Genome-wide Study of Families with Absolute Pitch Reveals Linkage to 8q24.21 and Locus Heterogeneity,” *The American Journal of Human Genetics* 85 (2009): 112–119; <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2706961/>.
- 38 “Central African Republic,” World Food Programme, accessed June 2, 2018, <http://www1.wfp.org/countries/central-african-republic>; Caroline H. D. Fall, “Fetal Malnutrition and Long-Term Outcomes,” in *Maternal and Child Nutrition: The First 1,000 Days*, Nestlé Nutrition Institute Workshop Series, 74 (2013): 11–25, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5081104/>.
- 39 Fridrih Niče, Tako je govorio Zaratustra (Dereta, Beograd, 2016): I, 3.
- 40 Paul Weindling, “Julian Huxley and the Continuity of Eugenics in Twentieth-century Britain,” *Journal of Modern European History*, November 1, 2012, accessed May 10, 2018, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4366572/>.

- 41 Tobiasz Mazan, Transcend the Flesh: Transhumanism Debate (2015): 8, https://www.researchgate.net/publication/279189548_Transcend_the_Flesh_Transhumanism_debate.
- 42 Doug Baily et al., “Transhumanist Declaration,” drafted in 1998 and adopted by Humanity+ in 2009, <http://humanityplus.org/philosophy/transhumanist-declaration/>.
- 43 Santi Tafarella, “What Did Friedrich Nietzsche Take from Charles Darwin?” Prometheus Unbound, 2010, <https://santitafarella.wordpress.com/2009/12/26/what-did-friedrich-nietzsche-take-from-charlesdarwin/amp/>.

Deveto poglavje

Mnogo nas je

- 1 Shepard Krech III, *The Ecological Indian: Myth and History* (New York: W. W. Norton & Company, 2000). Ako ćemo pravo, pitanje da li su ljudi krivi za ovo izumiranje i dalje je predmet usijane rasprave među arheolozima. Za argument koji podržava ovu teoriju, vid. Gary Haynes, “The Catastrophic Extinction of North American Mastodons and Mastodons,” *World Archaeology* 33, no. 3 (2002): 391–416, <https://www.homeworkmarket.com/files/week2-paleoindian-zip>. Za suprotstavljeni stanovište, vid. Donald Grayson, “Clovis Hunting and Large Mammal Extinction: A Critical Review of the Evidence,” *Clovis Hunting and Large Mammal Extinction: A Critical Review of the Evidence* 16, no. 4 (December 2012), https://www.researchgate.net/publication/40661225_Clovis_Hunting_and_Large_Mammal_Extinction_A_Critical_Review_of_the_Evidence.
- 2 Stari zavet, prevod Đure Daničića (Jugoslovensko biblijsko društvo, Beograd). <http://www.biblja.info/ijekav/index.htm>.

- 3 Chapter 3, The Works of Mencius, <http://nothingistic.org/library/mencius/mencius01.html>.
- 4 Frank Dikötter, *Mao's Great Famine: The History of China's Most Devastating Catastrophe, 1958–1962* (New York: Walker & Company, 2010).
- 5 Elizabeth C. Economy, *The River Runs Black: The Environmental Challenge to China's Future* (Cornell University Press, 2010). <https://journals.openedition.org/chinaperspectives/1473>.
- 6 Diamond v. Chakrabarty, 447 U.S. 303 (1980), <https://supreme.justia.com/cases/federal/us/447/303/case.html>.
- 7 Paul Berg et al., "Potential Biohazards of Recombinant DNA Molecules," *Science* 26 (1974): 303, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC388511/?page=1>.
- 8 Paul Berg et al., "Summary Statement of the Asilomar Conference on Recombinant DNA Molecules," *Proceedings of the National Academy of Sciences*, 72 (1975): 1981–1984, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC432675/pdf/pnas00049-0007.pdf>.
- 9 Rick Blizzard, "Genetically Altered Foods: Hazard or Harmless?" *Gallup News*, August 12, 2003, <http://news.gallup.com/poll/9034/genetically-altered-foods-hazard-harmless.aspx>.
- 10 Cary Funk and Brian Kennedy, "Public Opinion about Genetically Modified Foods and Trust in Scientists Connected with These Foods," *Pew Research Center*, December 1, 2016, <https://www.pewresearch.org/science/2016/12/01/public-opinion-about-genetically-modified-foods-and-trust-in-scientists-connected-with-these-foods/>.
- 11 "Genetically Modified Seeds Market—9.83% CAGR to 2020," *PR Newswire*, September 7, 2016, <https://www.prnewswire.com/news-releases/genetically-modified-seeds-market---983-cagr-to-2020-592549281.html>.
- 12 Za odličan pregled regulative GM useva u Kini, vid. Alice Yuen-Ting Wong and Albert Wai-Kit Chan, "Genetically Modified Foods in China and the United States: A Primer of Regulation and Intellectual Property Protection," *Food Science and Human*

- Wellness 5 no. 3 (2016): 124–140, <https://www.sciencedirect.com/science/article/pii/S2213453016300076>.
- 13 Chuin Wei-Yap, "Xi's Remarks on GMO Signal Caution," *Wall Street Journal*, October 9, 2014, <https://blogs.wsj.com/chinarealtime/2014/10/09/xis-remarks-on-gmo-signal-caution/>.
- 14 "ChemChina Clinches Its \$43 Billion Takeover of Syngenta," *Fortune*, May 5, 2017, <http://fortune.com/2017/05/05/chemchina-syngenta-deal-acquisition/>.
- 15 Christina Larson, "Can the Chinese Government Get Its People to Like GMOs?" *New Yorker*, August 31, 2015, <https://www.newyorker.com/tech/elements/can-the-chinese-government-get-its-people-to-like-g-m-o-s>.
- 16 Fei Han et al., "Attitudes in China about Crops and Foods Developed by Biotechnology," *Plos One* 10 (2015), <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0139114>.
- 17 "Statement by the AAS Board of Directors on Labeling of Genetically Modified Foods," *American Association for the Advancement of Science*, June 12, 2013, <https://www.aaas.org/news/statementaaas-board-directors-labeling-genetically-modified-foods>.
- 18 Rod A. Herman and William D. Price, "Unintended Compositional Changes in Genetically Modified (GM) Crops: 20 Years of Research," *Journal of Agricultural and Food Chemistry* 61 (2013): 11695–11701, <http://pubs.acs.org/doi/full/10.1021/jf400135r>.
- 19 A Decade of EU-Funded GMO Research (2001–2010), European Commission on Food, Agriculture and Fisheries and Biotechnology, 2010, https://ec.europa.eu/research/biosociety/pdf/a_decade_of_eufunded_gmo_research.pdf.
- 20 Safety Assessment of Foods Derived from Genetically Modified Microorganisms: Report of a Joint FAO/WHO Expert Consultation on Foods Derived from Biotechnology, WHO Headquarters, Geneva, Switzerland, September 24–28, 2001, <http://www.fao.org/3/a-ae585e.pdf>.

- 21 Report 2 of the Council on *Science* and Public Health (A-12) Labeling of Bioengineered Foods (Resolutions 508 and 509-A-11), 2012, <http://ag.utah.gov/documents/AMA-BioengineeredFoods.pdf>.
- 22 Read Safety of Genetically Engineered Foods: Approaches to Assessing Unintended Health Effects at NAP.edu. National Academies Press: OpenBook, accessed April 30, 2018, <https://www.nap.edu/read/10977/chapter/1>.
- 23 Genetically Modified Plants for Food Use and Human Health—An Update, Policy Document 4/02, February 2002, https://royalsociety.org/~media/royal_society_content/policy/publications/2002/9960.pdf.
- 24 Genetically Engineered Crops: Experiences and Prospects, National Academies of Sciences, Engineering, and Medicine (Washington, DC: The National Academies Press, 2016): 15, <https://doi.org/10.17226/23395>.
- 25 Elisa Pellegrino et al., “Impact of Genetically Engineered Maize on Agronomic, Environmental and Toxicological Traits: A Meta-analysis of 21 Years of Field Data,” *Scientific Reports* 8 (2018), <https://www.nature.com/articles/s41598-018-21284-2>.
- 26 Rebecca Goldburg et al., Biotechnology’s Bitter Harvest, Biotechnology Working Group, March 1990, <http://blog.ucsusa.org/wp-content/uploads/2012/05/Biotechnologys-Bitter-Harvest.pdf>.
- 27 Za fer procenu rada Monsanta, vid. Drake Bennett, “GMO Factory Monsanto’s High-Tech Plans to Feed the World,” Bloomberg.com, July 4, 2014, accessed May 10, 2018, <https://www.bloomberg.com/news/articles/2014-07-03/gmo-factory-monsantos-high-tech-plans-tofeed-the-world>.
- 28 Eurobarometer Biotechnology Report, October 2010, http://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_341_en.pdf.
- 29 Karl Haro von Mogel, “GMO Crops Vandalized in Oregon,” Biology Fortified, June 24, 2013, <https://www.biofortified.org/2013/06/gmo-crops-vandalized-in-oregon/>.

- 30 Tom Nightingale, “Scientists Speak Out against Vandalism of Genetically Modified Rice,” ABC News, September 19, 2013, <http://www.abc.net.au/news/2013-09-20/scientists-speak-out-against-vandalismof-gm-rice/4970626>. Indijska anti-GMO aktivistkinja Vandana Šiva tvrdi da je Zelena revolucija, koja je verovatno spasla čak milijardu života, zapravo i prouzrokovala glad, te da je “zlatni pirinač” podvala.
- 31 Mark Lynas, “With G.M.O. Policies, Europe Turns against Science,” *New York Times*, October 24, 2015, <https://www.nytimes.com/2015/10/25/opinion/sunday/with-gmo-policies-europe-turns-againstscience.html?mtrref=www.google.com&assetType=opinion>.
- 32 “EASAC Warns EU Policy on GM Crops Threatens the Future of Our Agriculture,” The Royal Netherlands Academy of Arts and Sciences, July 10, 2013, <https://www.knaw.nl/en/news/news/easacwarns-eu-policy-on-gm-crops-threatens-the-future-of-our-agriculture>.
- 33 Za optužujuću procenu efikasnosti nemačkih Zelene partije u podrivanju biotehnoloških inovacija u toj zemlji, vid. Günther, Susanne, “How Anti-GMO Advocates Hijacked German Science, Blocking Agricultural Innovation and Threatening the CRISPR Revolution: A Farmer’s Perspective,” Genetic Literacy Project, July 17, 2018, accessed August 5, 2018, <https://geneticliteracyproject.org/2018/07/12/how-anti-gmo-advocates-hijacked-german-scienceblocking-agricultural-innovation-threatening-crispr-revolution-farmers-perspective/>.
- 34 Paul Gander, “EU Enzyme Scrutiny Could Open Up GM ‘Can of Worms,’ ” Food Manufacture, August 8, 2012, <https://www.foodmanufacture.co.uk/Article/2012/08/09/Are-enzymes-processingaids-or-should-they-be-labelled-as-ingredients>.
- 35 Steven Cerier, “Anti-GMO Forces New Breeding Techniques (NBTs) Despite Similarities to Conventional Crops,” Genetic Literacy Project, February 26, 2018, <https://geneticliteracyproject.org/2018/02/26/anti-gmo-forces-target-new-breeding-techniques-nbtssdespite-similarities-conventional-crops>.

- 36 "Laureates Letter Supporting Precision Agriculture (GMOs)," Support Precision Agriculture, June 29, 2016, http://supportprecisionagriculture.org/nobel-laureate-gmo-letter_rjr.html.
- 37 "Organisms Obtained by Mutagenesis Are GMOs and Are, in Principle, Subject to the Obligations Laid down by the GMO Directive." Court of Justice of the European Union, PRESS RELEASE No 111/18, Luxembourg, 25 July 2018, Judgment in Case C-528/16, Confédération paysanne and Others v Premier ministre and Ministre de l'Agriculture, de l'Agroalimentaire et de la Forêt, <https://curia.europa.eu/jcms/upload/docs/application/pdf/2018-07/cp18011en.pdf>.
- 38 Callaway, Ewen. "CRISPR Plants Now Subject to Tough GM Laws in European Union," *Nature News*. July 25, 2018, accessed August 4, 2018, <https://www.nature.com/articles/d41586-018-05814-6>.
- 39 Marian Tupy, "Europe's Anti-GMO Stance Is Killing Africans," Reason, September 5, 2017, <http://reason.com/archives/2017/09/05/europees-anti-gmo-stance-is-killing-afric>.
- 40 "Laureates Letter Supporting Precision Agriculture (GMOs)," Support Precision Agriculture, June 29, 2016, http://supportprecisionagriculture.org/nobel-laureate-gmo-letter_rjr.html. Za više o opasnoj kampanji dezinformacija koju su anti-GMO organizacije povele protiv "zlatnog pirinča", vid. Andrew Porterfield, "Anti-GMO Groups Draw FDA Rebuke over Misrepresentation of Golden Rice Nutrition," Genetic Literacy Project, June 15, 2018, accessed June 18, 2018, https://geneticliteracyproject.org/2018/06/11/anti-gmo-groups-draw-fda-rebuke-overmisrepresentation-of-golden-rice-nutrition/?mc_cid=6c723bddd&mc_eid=6d7f502b6d.
- 41 Istraživači sa Državnog univerziteta Ajove nagovestili su da neki informativni mediji koje podržava Rusija proturaju na Zapadu anti-GMO vesti. "How Russia Tried to Turn America against GMOs and Agricultural Biotechnology and Sow Ideological Discord," Genetic Literacy Project, March 9, 2018, accessed August 4, 2018, <https://geneticliteracyproject.org/2018/03/06/>

- russia-tried-turn-america-gmosagricultural-biotechnology-sow-ideological-discord/.
- 42 National Academies of Sciences. "Science Breakthroughs to Advance Food and Agricultural Research by 2030," National Academies Press: OpenBook, July 18, 2018, accessed August 5, 2018, <https://www.nap.edu/catalog/25059/science-breakthroughs-to-advance-food-and-agricultural-researchby-2030>. <https://doi.org/10.17226/25059>; pp. 4-5.
- 43 Mireille Jacobson and Heather Royer, "Aftershocks: The Impact of Clinic Violence on Abortion Services," National Bureau of Economic Research, 2010, <http://users.nber.org/~jacobson/JacobsonRoyer6.2.10.pdf>.
- 44 "Violence Statistics & History," National Abortion Federation, <https://prochoice.org/education-and-advocacy/violence/violence-statistics-and-history/>.
- 45 "Public Funding for Abortion," American Civil Liberties Union, accessed May 1, 2018, <https://www.aclu.org/other/public-funding-abortion>.
- 46 Adam Taylor, "The Human Suffering Caused by China's One-Child Policy," *Washington Post*, October 29, 2015, https://www.washingtonpost.com/news/worldviews/wp/2015/10/29/the-human-sufferingcaused-by-chinas-one-child-policy/?utm_term=.d7fa61c5c3cb.
- 47 Justin Parkinson, "Five Numbers That Sum Up China's One-Child Policy," BBC News, October 29, 2015, <http://www.bbc.com/news/magazine-34666440>. Stvarna brojka je verovatno manja od 400 miliona, pošto bi se natalitet u zemlji gotovo sigurno smanjio u skladu s ekonomskim razvojem i porastom nivoa obrazovanja.
- 48 David Masci, "Where Major Religious Groups Stand on Abortion," Pew Research Center, June 21, 2016, <http://www.pewresearch.org/fact-tank/2016/06/21/where-major-religious-groups-stand-onabortion/>.
- 49 "Views about Abortion," Pew Research Center, 2014, <http://www.pewforum.org/religious-landscapestudy/views-about-abortion/>.

- 50 Lester Feder, Jeremy Singer-Vine, and Jina Moore, "This Is How 23 Countries around the World Feel about Abortion," Buzzfeed News, June 4, 2015, https://www.buzzfeed.com/lesterfeder/this-is-how-23-countries-around-the-world-feel-about-abortion?utm_term=.veJX3nrV4#.swW7R0kQ8. Pjuova anketa iz 2014. godine ustanovila je da se abortusu najviše na mahom katoličkim Filipinima, dok najmanje protivnika prava na prekid trudniće ima u mahom sekularnoj Francuskoj. "Global Views on Mortality," Pew Research Center, <http://www.pewglobal.org/2014/04/15/global-morality/table/abortion/>.
- 51 Angelina E. Theodorou and Aleksandra Sandstrom, "How Abortion Is Regulated around the World," Pew Research Center, October 6, 2015, <http://www.pewresearch.org/fact-tank/2015/10/06/how-abortion-is-regulated-around-the-world/>.
- 52 Gina Pollack, "Undue Burden: Trying to Get an Abortion in Louisiana," *New York Times*, May 16, 2017, https://www.nytimes.com/2017/05/16/opinion/abortion-restrictions-louisiana.html?_r=0.
- 53 Joshua Seitz, "Striking a Balance: Policy Considerations for Human Germline Modification." Santa Clara Journal of International Law 16, no. 1 (March 2, 2018): 60–100, accessed June 18, 2018, <https://digitalcommons.law.scu.edu/cgi/viewcontent.cgi?article=1225&context=scujil>. Za zanimljiv osvrt na to kako rasprava o editovanju gena stvara čudna savezništva među protivnicima prava na abortus, vid. Sarah Karlin et al., "Gene Editing: The Next Frontier in America's Abortion Wars," February 16, 2016, accessed May 29, 2018, <https://www.politico.com/story/2016/02/gene-editingabortion-wars-219230>.
- 54 See "Alliance VITA 'Stop GM Babies' Awareness-Raising Campaign Confirmed by the Results of an Opinion Poll on CRISPR-Cas9," Alliance Vita, May 27, 2016, accessed June 24, 2018, <https://www.alliancevita.org/en/2016/05/alliance-vita-stop-gm-babies-awareness-raising-campaignconfirmed-by-the-results-of-an-opinion-poll-on-crispr-cas9/>.

- 55 Heather Mason Kiefer, "Gallup Brain: The Birth of In Vitro Fertilization," Gallup, August 5, 2003, <http://news.gallup.com/poll/8983/gallup-brain-birth-vitro-fertilization.aspx>; "Abortion Viewed in Moral Terms: Fewer See Stem Cell Research and IVF as Moral Issues," Pew Research Center, August 5, 2013, <http://www.pewforum.org/2013/08/15/abortion-viewed-in-moral-terms/>.
- 56 "Awareness and Knowledge about Reproductive Genetic Technology," Genetics and Public Policy Center, 2002, <https://jscholarship.library.jhu.edu/bitstream/handle/1774.2/979/PublicAwarenessAndAttitudes.pdf?sequence=1>.
- 57 "The Public and Genetic Editing, Testing, and Therapy," Harvard T. H. Chan School of Public Health, January 2016, <https://cdn1.sph.harvard.edu/wp-content/uploads/sites/94/2016/01/STAT-Harvard-Poll-Jan-2016-Genetic-Technology.pdf>.
- 58 Funk, Cary, and Meg Hefferon. "Public Views of Gene Editing for Babies Depend on How It Would Be Used," Pew Research Center: Internet, Science & Tech, July 26, 2018, accessed August 27, 2018, <http://www.pewinternet.org/2018/07/26/public-views-of-gene-editing-for-babies-depend-on-how-itwould-be-used/>.
- 59 "The Public and Genetic Editing, Testing, and Therapy."
- 60 "Results of Major Surveys on Attitudes to Human Genetics," Ipsos Mori, March 1, 2001, <https://www.ipsos.com/ipsos-mori/en-uk/results-major-survey-attitudes-human-genetics>.
- 61 "Industry News: UK Public Cautiously Optimistic about Genetic Technologies," SelectScience, March 8, 2018, <http://www.selectscience.net/industry-news/uk-public-cautiously-optimistic-about-genetictechnologies/?artID=45918>. Premda je britanska populacija izuzetno napredovala u pravcu prihvatanja humanog genetičkog inženjeringu, ironično je što je svega pedeset jedan odsto ispitanih podržalo primenu genetičkih tehnologija u svrhu unapređenja efikasnosti proizvodnje hrane. Drugim rečima, Britanaca koji podržavaju genetsko modifikovanje svoje dece ima čitavih dvadeset pet odsto više nego onih koji podržavaju genetsko modifikovanje kumkvata.

- 62 Fung-Kei Cheng, "Taijiao: A Traditional Chinese Approach to Enhancing Fetal Growth through Maternal Physical and Mental Health," *Chinese Nursing Research* 3 (2016): 49–53, <http://www.sciencedirect.com/science/article/pii/S2095771816300470>; Baoqui Su and Darryl R. J. Macer, "Chinese People's Attitudes towards Genetic Diseases and People with Handicaps," *Law and Human Genome Review* 18 (2003): 191–210, <http://www.eubios.info/Papers/yousheg.htm>.
- 63 David Cyranoski, "China's Embrace of Embryo Selection Raises Thorny Questions," *Nature* 548 (2017): 272–274, <https://www.nature.com/news/china-s-embrace-of-embryo-selection-raises-thornyquestions-1.22468>.
- 64 Jiang-Hui Wang et al., "Public Attitudes toward Gene Therapy in China," *Molecular Therapy Methods & Clinical Development* 6 (2017); <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5480269/>.
- 65 Tristan McCaughey et al., "A Global Social Media Survey of Attitudes to Human Genome Editing," *Cell Stem Cell* 18 (2016): 569–572, <https://www.sciencedirect.com/science/article/pii/S1934590916300546>.
- 66 "Is Pre-implantation Genetic Diagnosis (PGT) Acceptable for Catholics?" Institute of Catholic Bioethics, January 6, 2014, <https://sites.sju.edu/icb/is-pre-implantation-genetic-diagnosis-PGTacceptable-for-catholics/>.
- 67 Ioannes Paulus PP. II, "Evangelium Vitae," 1995, http://w2.vatican.va/content/john-paulii/en/encyclicals/documents/hf_jp-ii_enc_25031995_evangelium-vitae.html.
- 68 Edward Pentin, "The Brave New World of Three-Parent Babies," National Catholic Register, October 2, 2013, <http://www.ncregister.com/daily-news/the-brave-new-world-of-three-parent-babies>.
- 69 "Fearfully and Wonderfully Made: A Policy on Human Biotechnologies," National Council of Churches, adopted November 8, 2006, <http://nationalcouncilofchurches.us/commonwitness/2006/biotech.php>.

- 70 Christopher Benek, "Religion+ for Humanity+," *H+ Magazine*, March 25, 2014, <http://hplusmagazine.com/2014/03/25/religion-for-humanity/>.
- 71 Rabbi Moshe D. Tendler and John D. Loike, "Mitochondrial Replacement Therapy: Halachic Considerations for Enrolling in an Experimental Clinical Trial," *Rambam Maimonides Medical Journal* 6 (2015), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4524404/>.
- 72 Jaron Lanier, "The First Church of Robotics," *New York Times*, August 9, 2010, http://www.nytimes.com/2010/08/09/opinion/09lanier.html?_r=1; Jaron Lanier, "Singularity Is a Religion Just for Digital Geeks," *BigThink*, March 11, 2011, <http://bighink.com/devilsadvocate/singularity-is-a-religion-just-for-digital-geeks>.
- 73 Susannah Baruch, David Kaufman, and Kathy L. Hudson, "Genetic Testing of Embryos: Practices and Perspectives of U.S. In Vitro Fertilization Clinics," *Fertility and Sterility* 89 (2008): 1053–1058, <https://www.sciencedirect.com/science/article/pii/S0015028207012162>.
- 74 Bettina Bock von Wülfingen, "Contested Change: How Germany Came to Allow PGT," *Reproductive Biomedicine and Society Online* 3 (2016): 60–67, <http://www.sciencedirect.com/science/article/pii/S2405661816300387>.
- 75 Michelle J. Bayefsky, "Comparative Preimplantation Genetic Diagnosis Policy in Europe and the USA and Its Implications for Reproductive Tourism," *Reproductive Biomedicine and Society Online* 3 (2016): 41–47, <https://www.sciencedirect.com/science/article/pii/S2405661817300047>.
- 76 "Cross-Border Reproductive Care: A Committee Opinion," *Fertility and Sterility* 100(2013): 645–650, [http://www.fertstert.org/article/S0015-0282\(13\)00396-8/fulltext](http://www.fertstert.org/article/S0015-0282(13)00396-8/fulltext).
- 77 U toku je aktivna rasprava o tome da li je Kina genetički Divlji zapad. Za argument u prilog tome, vid. Didi Kirsten Tatlow, "A Scientific Ethical Divide Between China and West," *New York Times*, June 29, 2015, <https://www.nytimes.com/2015/06/30/science/a-scientific-ethical-divide-betweenchina-and-west>.

- html. Za dobro artikulisano suprotno mišljenje, vid. Douglas Sipp and Duanqing Pei, "Bioethics in China: No Wild East," *Nature* 534 (2016): 465–467, <https://www.nature.com/news/bioethics-in-china-no-wild-east-1.20116>; and Ian Johnson and Cao Li, "China Experiences a Booming Underground Market in Surrogate Motherhood," *New York Times*, August 2, 2014, <https://www.nytimes.com/2014/08/03/world/asia/china-experiences-a-booming-blackmarket-in-child-surrogacy.html>. Vid. i *Genome Editing and Human Reproduction. Report. July 17, 2018, Nuffield Council on Bioethics.* <http://nuffieldbioethics.org/wp-content/uploads/Genome-editingand-human-reproduction-FINAL-website.pdf>, 110–111.
- 78 Alta R. Charo, "On the Road (to a Cure?)—Stem-Cell Tourism and Lessons for Gene Editing," *New England Journal of Medicine* 374 (2016): 901–903, <http://www.nejm.org/doi/full/10.1056/NEJMp1600891>.
- 79 Mahsa Shabani and Pascal Borry, "Rules for Processing Genetic Data for Research Purposes in View of the New EU General Data Protection Regulation," *European Journal of Human Genetics* 26, no. 2 (2017): 149–56, doi:10.1038/s41431-017-0045-7, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5838983/>.
- 80 Richard Bird, "Where Are We Now with Data Protection Law in China?" Freshfields Bruckhaus Deringer, 2017, <https://digital.freshfields.com/post/102fqnd/where-are-we-now-with-data-protection-law-in-china-updated-september-2019>.
- 81 Wenxin Fan, Natasha Khan, and Liza Lin, "China Snakes Innocent and Guilty Alike to Build World's Biggest DNA Database," *Wall Street Journal*, December 26, 2017, <https://www.wsj.com/articles/chinasnares-innocent-and-guilty-alike-to-build-worlds-biggest-dna-database-1514310353>; Echo Huang, "China Is Creating a Massive 'Orwellian' DNA Database," *Quartz*, May 16, 2017, <https://qz.com/984400/china-is-creating-a-massive-orwellian-dna-database-to-construct-harmo-nicsociety/>; "China: Police DNA Database Threatens Privacy," May 15, 2017, *Human Rights Watch*, <https://www.hrw.org/news/2017/05/15/china-police-dna-database-threatens-privacy>.

Za više o represiji u Sinkjiangu, uključujući i traženje od građana ujgarske nacionalnosti da daju uzorke krvi, vid. "China Has Turned Xinjiang into a Police State Like No Other," *The Economist*, May 31, 2018, accessed June 3, 2018, <https://www.economist.com/briefing/2018/05/31/china-has-turned-xinjiang-into-a-police-state-like-no-other?frsc=dg|e>. U avgustu 2019, Panel Ujedinjenih nacija o ljudskim pravima objavio je kako je dobio verodostojne izveštaje o tome da Kina drži približno milion Ujgura u "masovnim logorima za internaciju" Reuters. "U.N. Says It Has Credible Reports That China Holds Million Uighurs in Secret Camps." *New York Times*, August 10, 2018, accessed August 15, 2018, <https://www.nytimes.com/reuters/2018/08/10/world/asia/10reuters-china-rights-un.html>. Peking je, nimalo iznenađujuće, smesta odbacio ovu tvrdnju. "China Has Prevented 'Great Tragedy' in Xinjiang, State-Run Paper Says," Reuters, August 13, 2018, accessed August 15, 2018, <https://www.reuters.com/article/us-china-rights-un-china-has-prevented-great-tragedy-in-xinjiangstate-run-paper-says-idUSKBN1KY01B?il=0>. Britanski Hous ofis je 2018. Takođe istraživao mogućnost stvaranja centralizovane baze svih biometrijskih podataka prikupljenih od građana Ujedinjenog Kraljevstva.

Deseto poglavlje

Trka u naoružanju ljudske rase

- 1 Harvardov psiholog Steven Pinker iznosi ubedljive argumente za ovo. Steven Pinker, *Enlightenment Now: The Case for Reason, Science, Humanism, and Progress* (London: Allen Lane, 2018).
- 2 Budući da su koncepti genetike utemeljeni na nedovoljnem poznavanju te nauke vekovima ležali u usnovi rasizma, kolonijalizma, eugenike i diskriminacije, diskusije o genetici i nekim specifičnim ishodima poput sportske snage veoma su osetljive.

- Za promišljeno razmatranje teškoća povezanih s istraživanje genetike i ras vid. David Reich, "How Genetics Is Changing Our Understanding of 'Race,'" *New York Times*, March 23, 2017, <https://www.nytimes.com/2018/03/23/opinion/sunday/genetics-race.html> i Sidarta Mukardži, *Gen: Intimna istorija* (Laguna, Beograd, 2018).
- 3 David J. Epstein, *The Sports Gene: What Makes the Perfect Athlete* (London: Yellow Jersey Press, 2013). See also: A. de la Chapelle, A. L. Traskelin, and E. Juvonen, "Truncated Erythropoietin Receptor Causes Dominantly Inherited Benign Human Erythrocytosis," *Proceedings of the National Academy of Sciences* 90 (1993): 4495–4499, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC46538/pdf/pnas01462-0175.pdf>; David Epstein, "Eero Mäntyranta–Finland's Champion. 1937–2013: Obituary," *The Science of Sport*, December 31, 2013, <https://sportsscientists.com/2013/12/eero-mantyranta-finlands-champion-1937-2013-obituary/>.
 - 4 Eynon et al., "Genes for Elite Power and Sprint Performance: ACTN3 Leads the Way." *Sports Medicine*, September 2013, accessed May 1, 2018, <https://www.ncbi.nlm.nih.gov/pubmed/23681449>.
 - 5 Ross Tucker, Vincent O. Onywera, and Jordan Santos-Concejero, "Analysis of the Kenyan Distance-Running Phenomenon," *International Journal of Sports Physiology and Performance* 10 (2015): 285–291, https://www.researchgate.net/publication/264745551_Analysis_of_the_Kenyan_Distance-Running_Phenomenon.
 - 6 Da budemo načisto, ovaj uspeh nije se temeljio samo na genetički već je bio rezultat složene interakcije genotipskih, fenotipskih i društvenoekonomskih faktora. Tema je još predmet usijanih rasprava. Vid. Max Fisher, "Why Kenyans Make Such Great Runners: A Story of Genes and Cultures." *The Atlantic*, April 17, 2012, accessed June 6, 2018, <https://www.theatlantic.com/international/archive/2012/04/why-kenyans-make-such-great-runners-a-story-of-genes-and-cultures/256015/>; and Alex Hutchinson, "Kenyan Dominance, Real

and Imagined," *Runner's World*, May 25, 2018, accessed June 6, 2018, <https://www.runnersworld.com/training/a20846404/kenyan-dominance-real-and-imagined/>.

- 7 Andrew Roos and Thomas Roos, "Genetics of Athletic Performance," Stanford University, May 15, 2012, <https://web.stanford.edu/class/gene210/files/projects/Gene210-AthleticsPresentation-Roos.pdf>.
- 8 Olimpijski zvaničnici prvi put su testirali sportiste na „genski doping“ 2016, na Olimpijadi u Riju, da provere ima li dokaza o genskim terapijama u svrhu povećanja sposobnosti organizma datog sportista da prizvodi crvene krvne ćelije. Eric Niller, "Olympic Drug Cops Will Scan For Genetically Modified Athletes," *Wired*, July 28, 2016, <https://www.wired.com/2016/07/olympic-drug-cops-will-scan-genetically-modifiedathletes/>.
- 9 Nick Webborn et al., "Direct-to-Consumer Genetic Testing for Predicting Sports Performance and Talent Identification: Consensus Statement," *British Journal of Sports Medicine* 49 (2015): 1486–1491, <https://www.ncbi.nlm.nih.gov/pubmed/26582191>.
- 10 Ron Synovitz and Zamira Eshanova, "Uzbekistan Is Using Genetic Testing to Find Future Olympians," *The Atlantic*, February 6, 2014, <https://www.theatlantic.com/international/archive/2014/02/uzbekistan-is-using-genetic-testing-to-find-future-olympians/283001/>.
- 11 Hoon Choi and Lvaro Choi, "When One Door Closes: The Impact of the Hagwon Curfew on the Consumption of Private Tutoring in the Republic of Korea," *SSRN Electronic Journal* (2015), http://www.ub.edu/irea/working_papers/2015/201526.pdf.
- 12 Malleta, King, "Why Korean Parents Give Their Kids Plastic Surgery as Graduation Gifts," *NextShark*, December 23, 2016, accessed August 9, 2018, <https://nextshark.com/why-korean-parentsgive-their-kids-plastic-surgery-as-graduation-gifts/>; Wei, Will, "Why Korean Parents Are Having Their Kids Get Plastic Surgery before College." *Business Insider*, November 25,

- 2017, accessed August 09, 2018, <https://www.businessinsider.com/eyelid-surgery-in-south-korea-2015-11>.
- 13 Patricia Marx, "About Face," *New Yorker*, March 23, 2015, <https://www.newyorker.com/magazine/2015/03/23/about-face>.
- 14 William Wan, "In China, Parents Bribe to Get Students into Top Schools, Despite Campaign against Corruption," *Washington Post*, October 7, 2013, <https://news.tfonline.com/post/63547495851/in-china-parents-bribe-to-get-students-into-top>.
- 15 Kitty Bu and Maxim Duncan, "Playtime a Luxury for Competitive Chinese Kids," *Reuters*, November 23, 2009, <https://www.reuters.com/article/us-china-children-play/playtime-a-luxury-for-competitivechinese-kids-idUSTRE5AM16920091123>.
- 16 Peter Foster, "Third of Chinese Primary School Children Suffer Stress, Study Finds," *The Telegraph*, January 19, 2010, <https://www.telegraph.co.uk/news/worldnews/asia/china/7027377/Third-of-Chineseprimary-school-children-suffer-stress-study-finds.html>.
- 17 Alvin A. Rosenfeld and Nicole Wise, *The Over-Scheduled Child: Avoiding the Hyper-Parenting Trap* (New York: St. Martins Griffin, 2001).
- 18 Timothy Caulfield et al., "Marginally Scientific? Genetic Testing of Children and Adolescents for Lifestyle and Health Promotion," *Journal of Law and the Biosciences* 2 (2015): 627–644, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5034400/>.
- 19 Antonio Regaldo, "Baby Genome Sequencing for Sale in China," *MIT Technology Review*, June 15, 2017, <https://www.technologyreview.com/s/608086/baby-genome-sequencing-for-sale-in-china/>.
- 20 Kalokairinou et al., "Legislation of Direct-to-Consumer Genetic Testing in Europe: A Fragmented Regulatory Landscape," *Journal of Community Genetics* 9 (2018): 117–132. U Sjedinjenim Državama, kompanije kao što su Salesforce, OpenTable i Snap sada nude svojim zaposlenima besplatni genetski skrining u svrhu procene rizika od naslednih genetskih

- oboljenja. Godine 2018, kreativni istražitelji postavili su lažne genetske profile, prikazavši ih kao rezultate "instant" genetskog testiranja, zasnovane na uzorcima DNK prikupljenim na mestima zločina četiri decenije pre tog, kako bi identifikovali genetske srodnike počinioca, što je naposletku urodilo hvatanjem tzv. Ubice iz Zlatne države (Golden State Killer). Jasno je, dakle, da se ne sme dozvoliti nekontrolisani pristup genetskim informacijama. Megan Molteni, "The Creepy Genetics Behind the Golden State Killer Case," *Wired*, May 4, 2018, accessed May 29, 2018, <https://www.wired.com/story/detectives-cracked-the-golden-statekiller-case-using-genetics/>. Vid. i <https://www.krstarica.com/zdravlje/tegobe/genetsko-testiranje-sklonosti-ka-bolestima-veca-steta-nego-korist/>.
- 21 S. Roberts et al., "Direct-to-Consumer Genetic Testing: User Motivations, Decision Making, and Perceived Utility of Results," *Public Health Genomics* 20, no. 1, (January 10, 2017): 36–45, accessed May 1, 2018. <https://www.ncbi.nlm.nih.gov/pubmed/28068660>. Za potpuni spisak referenci o ovoj temi, vid. http://www.genomes2people.org/wp-content/uploads/2018/01/PGen_Publications.pdf.
- 22 Francis Fukuyama, "The End of History?" *The National Interest*, no. 16 (Summer 1989): 3–18, <http://www.jstor.org/stable/24027184>.
- 23 Elsa B. Kania, *Battlefield Singularity: Artificial Intelligence, Military Revolution, and China's Future Military Power*, Center for a New American Security, November 2017, 51, <https://s3.amazonaws.com/files.cnas.org/documents/Battlefield-Singularity-November-2017.pdf?mtime=20171129235804>.
- 24 The National Artificial Intelligence Research and Development Strategic Plan, National Science and Technology Council, October 2016, https://www.nitrd.gov/pubs/national_ai_rd_strategic_plan.pdf.
- 25 Objavio: State Council New Generation Artificial Intelligence Development Planning Notice No. 35 [2017] The People's Governments of Provinces, Autonomous Regions, and Municipalities Directly under the Central Government,

- the Ministries and Commissions of the State Council, and the Agencies Directly under the State Council, July 8, 2017, accessed June 18, 2018, http://www.gov.cn/zhengce/content/2017-07/20/content_5211996.htm.
- 26 Ma Si, "Key AI Guidelines Unveiled," China Daily, December 15, 2017, <http://www.chinadaily.com.cn/a/201712/15/WS5a330a41a3108bc8c6734c64.html>; Neil Connor, "Anxious Chinese Parents Cause Gene Testing Boom as They Try to Discover Young Children's Talents," The Telegraph, February 11, 2017, <http://www.telegraph.co.uk/news/2017/02/11/anxiouschinese-parents-fuel-gene-testing-boom-try-discover/>.
- 27 "Chinese AI Startups Scored More Funding Than America's Last Year," MIT Technology Review, February 14, 2018, <https://www.technologyreview.com/the-download/610271/chinas-ai-startups-scored-more-funding-than-americas-last-year/>.
- 28 Graham Webster et al., "China's Plan to 'Lead' in AI: Purpose, Prospects, and Problems," New America, August 1, 2017, <https://www.newamerica.org/cybersecurity-initiative/blog/chinas-plan-lead-ai-purpose-prospects-and-problems/>.
- 29 Vid. Coral Davenport, "In the Trump Administration, *Science* Is Unwelcome. So Is Advice," *New York Times*, June 9, 2018, accessed June 18, 2018, <https://www.nytimes.com/2018/06/09/climate/trumpadministration-science.html>.
- 30 Chappellet-Lanier, Tajha, "White House Announces Creation of Select Committee on Artificial Intelligence," Fedscoop, May 10, 2018, accessed August 09, 2018, <https://www.fedscoop.com/whitehouse-artifical-intelligence-committee-kratsios/>.
- 31 David Cyranoski, "China's Bid to Be a DNA Superpower," *Nature* 534 (2016): 462–463, <http://www.nature.com/news/china-s-bid-to-be-a-dna-superpower-1.20121>.
- 32 Susan Decker, "China Becomes One of the Top 5 U.S. Patent Recipients for the First Time," Bloomberg News, January 9, 2018, <https://www.bloomberg.com/news/articles/2018-01-09/chinaenters-top-5-of-u-s-patent-recipients-for-the-first-time>.
- 33 Reinhilde Veugelers, "China Is the World's New Science and Technology Powerhouse," Bruegel, August 30, 2017, <http://bruegel.org/2017/08/china-is-the-worlds-new-science-and-technology-powerhouse/>. Ben Guarino, Emily Rauhala, and William Wan, "China Increasingly Challenges American Dominance of Science," *Washington Post*, June 3, 2018, accessed June 6, 2018, https://www.washingtonpost.com/national/health-science/china-challenges-american-dominance-of-science/2018/06/03/c1e0cfe4-48d5-11e8-827e-190efaf1f1ee_story.html.
- 34 Kai-Fu Lee, "China's Artificial Intelligence Revolution: Understanding Beijing's Structural Advantages," Sinovation Ventures (December 2017), https://www.eurasia-group.net/files/upload/China_Embraces_AI.pdf.
- 35 Eleonore Pauwels and Apratim Vidyarthi, "Who Will Own the Secrets in Our Genes? A U.S.-China Race in Artificial Intelligence and Genomics," Wilson Center, February 2017, https://www.wilsoncenter.org/sites/default/files/who_will_own_the_secrets_in_our_genes.pdf.
- 36 Za zdravu raspravu na ovu temu, vid. Jennifer Kulynych and Henry T. Greely, "Clinical Genomics, Big Data, and Electronic Medical Records: Reconciling Patient Rights with Research When Privacy and *Science* Collide," *Journal of Law and the Biosciences* 4 (2017): 94–132, <https://www.ncbi.nlm.nih.gov/pubmed/28852559>. Vid. takođe Eryn Brown, "Geneticist on DNA Privacy: Make It So People Don't Care," *Los Angeles Times*, January 18, 2013, <http://articles.latimes.com/2013/jan/18/science/la-sci-sn-george-church-dna-genome-privacy-20130118>. Inovativne američke kompanije možda će naći načina da iskoriste blokčejn i ostale tehnologije da sastave različite fondove podataka uz istovremenu bolju zaštitu individualne privatnosti, ili da ubede veliki broj edukovanih građana da se dobrovoljno uključe.
- 37 iCarbonX, <https://www.icarbonx.com/>.
- 38 David Ewing Duncan, "Can AI Keep You Healthy?" MIT Technology Review, October 3, 2017, <https://www.technologyreview.com/s/608987/how-ai-will-keep-you-healthy/>.

- 39 Jun Wang, "How Digital DNA Could Help You Make Better Health Choices," TED17, https://www.ted.com/talks/jun_wang_how_digital_dna_could_help_you_make_better_health_choices/transcript#t-150728.
- 40 Jun Wang, "The Bank of Life Gene Concerning Everyone Is Now Coming," Medium, April 25, 2016, <https://medium.com/@iAskMedia/wang-jun-the-bank-of-life-gene-concerning-everyone-is-nowcoming-335353aaaf3ee>.
- 41 Henny Sender, "China's Tech Groups Are Building Too Much Power," Financial Times, August 28, 2017, <https://www.ft.com/content/858d0312-8988-11e7-8bb1-5ba57d47eff7>.
- 42 Tamar Lewin, "Coming to U.S. for Baby, and Womb to Carry It," New York Times, July 5, 2014, https://www.nytimes.com/2014/07/06/us/foreign-couples-heading-to-america-for-surrogate-pregnancies.html?_r=0.
- 43 "List of Invasions," Wikipedia, last modified July 28, 2018, https://en.wikipedia.org/wiki/List_of_invasions.
- 44 Robert Farley et al., "China vs. America: 3 Ways a War in the South China Sea Could Start," The National Interest, accessed June 24, 2018, <http://nationalinterest.org/blog/the-buzz/china-vs-america-3-ways-war-the-south-china-sea-could-start-26034>.

Jedanaesto poglavlje

Budućnost čovečanstva

- 1 Rob Carlson, "Splice it Yourself," Wired, May 1, 2005, <https://www.wired.com/2005/05/splice-it-yourself/>.
- 2 Bart Kolodziejczyk, "Do-It-Yourself Biology Shows Safety Risks of an Open Innovation Movement," Brookings Institute Techtank Blog, October 9, 2017, <https://www.brookings.edu/blog/techtank/2017/10/09/do-it-yourself-biology-shows-safety-risks-of-an-open-innovation-movement/>. Vid. takođe Mallory

Locklear, "These Kids Are Learning CRISPR At Summer Camp," Motherboard, July 27, 2017, https://motherboard.vice.com/en_us/article/kzavja/these-kids-are-learning-crispr-at-summer-camp. Dodatne informacije o ovoj temi autoru je dostavio Raymond McCauley, sa Singularity University, u imeju od 13. novembra 2018.

- 3 Lisa C. Ikemoto, "DIY Bio: Hacking Life in Bioetech's Backyard," UC Davis Law Review 51 (2017): 539–568, https://lawreview.law.ucdavis.edu/issues/51/2/Symposium/51-2_Ikemoto.pdf.
- 4 Vid. Emily Baumgaertner, "As D.I.Y. Gene Editing Gains Popularity, 'Someone Is Going to Get Hurt,'" New York Times, May 14, 2018, accessed May 31, 2018, <https://www.nytimes.com/2018/05/14/science/biohackers-gene-editing-virus.html>.
- 5 Sidarta Mukardži, Gen: Intimna istorija (Laguna, Beograd, 2018).
- 6 Kate Charlet, "The New Killer Pathogens: Countering the Coming Bioweapons Threat," Foreign Affairs, May/June 2018, <https://www.foreignaffairs.com/articles/2018-04-16/new-killer-pathogens>; Akshat Rathi, "This Could Be the Next Weapon of Mass Destruction," Quartz, November 20, 2015, accessed May 3, 2018. <https://qz.com/554337/this-could-be-the-next-weapon-of-mass-destruction/>.
- 7 Ryan S. Noyce, Seth Lederman, and David H. Evans, "Construction of an Infectious Horsepox Virus Vaccine from Chemically Synthesized DNA Fragments," Plos One 13, no. 1 (2018), doi:10.1371/journal.pone.0188453.
- 8 Sharon Begley, "Why FBI and the Pentagon Are Afraid of Gene Drives," STAT, April 19, 2018, accessed May 11, 2018, <https://www.statnews.com/2015/11/12/gene-drive-bioterror-risk/>.
- 9 James R. Clapper, "Worldwide Threat Assessment of the U.S. Intelligence Community," Senate Armed Services Community (February 9, 2016), 9, https://www.dni.gov/files/documents/SASC_Unclassified_2016_ATA_SFR_FINAL.pdf.

-
- 10 "Global Trends: Paradox of Progress," National Intelligence Council (January 2017), <https://www.dni.gov/files/documents/nic/GT-Full-Report.pdf>.
- 11 National Academies of Sciences, Engineering, and Medicine. Biodefense in the Age of Synthetic Biology (Washington, DC: National Academies Press, 2018). <https://www.nap.edu/catalog/24890/biodefense-in-the-age-of-synthetic-biology>, doi:10.17226/24890.
- 12 Richard A. Clarke and R. P. Eddy, *Warnings: Finding Cassandras to Stop Catastrophes* (Harper Collins, 2017).
- 13 Amy Gutmann and Jonathan Moreno, "Keep CRISPR Safe: Regulating a Genetic Revolution," *Foreign Affairs*, April 25, 2018, accessed May 3, 2018, <https://www.foreignaffairs.com/articles/2018-04-16/keep-crispr-safe>.
- 14 Neki važni sastanci na kojima se raspravljalo o ovome održani su u Napi (Kalifornija), Mančesteru (Engleska), Vašingtonu DC i Hongkongu. "International Summit on Human Gene Editing: A Global Discussion," National Academies Press, December 1–3, 2015, <https://www.ncbi.nlm.nih.gov/books/NBK343651/>; *Human Genome Editing: Science, Ethics, and Governance* (Washington, DC: National Academies Press, 2017): 5, 8–9; "Statement on Genome Editing Technologies and Human Germline Genetic Modification," The Hinxton Group, Sept 3–4, 2015, http://www.hinxtongroup.org/Hinxton2015_Statement.pdf.
- 15 Citat naveden u *Human Enhancement*, ed. Nick Bostrom and Julian Savulescu (Oxford: Oxford University Press, 2009): 132.
- 16 Jamie Metzl, "Brave New World War," *Democracy* 8, no. 8 (Spring 2008), <https://democracyjournal.org/magazine/8/brave-new-world-war/>.
- 17 "UNESCO Panel of Experts Calls for Ban on 'Editing' of Human DNA to Avoid Unethical Tampering with Hereditary Traits," UNESCO, 2015, <https://en.unesco.org/news/unesco-panel-experts-calls-ban-editing-human-dna-avoid-unethical-tampering-hereditary-trait>.
- 18 "Statement on Genome Editing Technologies," Committee on Bioethics (2015), document DHBIO/INF (2015) 13, <https://rm.coe.int/168049034a>.
- 19 The United Nations Office on Genocide Prevention and the Responsibility to Protect, <http://www.un.org/en/genocideprevention/about-responsibility-to-protect.html>.
- 20 Edward O. Wilson, *The Social Conquest of Earth* (New York: Liveright Publishing, 2013): 7.
- 21 Genome Editing—Progress Educational Trust, accessed August 5, 2018, <https://www.progress.org.uk/genomeediting>.
- 22 Genome Editing and Human Reproduction, Report, July 17, 2018, Nuffield Council on Bioethics, <http://nuffieldbioethics.org/wp-content/uploads/Genome-editing-and-human-reproduction-FINAL-website.pdf>, 142.